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ORIGINAL STUDY

Pharmacy Students' Perceptions and Attitudes Toward Online Learning: Insights from a Cross-Sectional Study in Iraq

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ABSTRACT

Background: The rapid shift to online learning during the pandemic has reshaped pharmacy education in Iraq, yet student perceptions remain underexplored. This study examines how pharmacy students view online and hybrid models, with attention to gender, location, and access to technology.

Method: A cross-sectional online survey was conducted between October 2024 and January 2025 with 386 fourth- and fifth-year pharmacy students from differrent universities across Iraq. Data were collected using a structured questionnaire adapted from validated tools, assessing demographics, learning preferences, and attitudes toward digital education. Descriptive and inferential statistics were analyzed using SPSS version 25.

Results: Most participants were female (72.5%) and lived in urban areas (77.5%). The mean perception score was 22.48 (SD = 8.5), indicating moderate acceptance of online learning. Male students and those from rural areas reported more favorable views. Smartphones were the primary learning device for 81.1% of students. While many appreciated the flexibility of online formats, concerns persisted about practical skill development and future employability. Over half preferred face-to-face instruction, citing poor internet, lack of interaction, and unsuitability for lab-based courses.

Conclusions: Pharmacy students in Iraq show moderate and context-dependent attitudes toward online learning. Their preferences are shaped not only by infrastructure but also by geography, gender, and lived experience. As institutions move toward blended models, efforts should focus on mobile-optimized content, faculty training, and innovative teaching strategies that support practical learning in digital environments.

Keywords: Pharmacy education, Online learning, Perceptions, Attitudes, Blended learning, Iraq

1. Introduction

Across the world, higher education has gradually embraced online learning over the last few decades, driven by advances in digital technology and the demand for flexible study options (Zou et al., 2025). Pharmacy education traditionally emphasizes a delicate equilibrium between comprehensive theoretical instruction and hands-on practical training. While online or hybrid instructional models offer flexibility and efficiency, they often struggle to replicate the immersive, skill-based learning that is integral to pharmacy practice, particularly laboratory work, patient counseling, and clinical simulations. These limitations highlight both the opportunities and friction points inherent in applying digital approaches to a discipline grounded in tactile competency (Elendu et al., 2024; Muhaimin et al., 2023).

In Iraq, this transition was abrupt. Before 2020, digital classrooms were largely absent in pharmacy

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schools, and instruction was firmly anchored in face-to-face methods. The COVID-19 pandemic forced an immediate shift to remote learning, often with little institutional preparation or infrastructure to support it (Mohammed, Rashid, and Abbas, 2023). A report from the University of Baghdad's College of Pharmacy emphasizes how the institution, with minimal prior digital infrastructure, rapidly pivoted to full-distance learning to ensure students could complete their academic year and graduate on time (Ahmed et al., 2020).

Looking beyond Iraq, several systematic reviews of health sciences education worldwide during the pandemic underscore mixed student experiences. For example, a comprehensive review of undergraduate health sciences students found that while about half expressed moderate satisfaction with online learning, common challenges included poor internet connectivity and reduced interaction with instructors (Abdull Mutalib, Akim, and Jaafar, 2022).

In pharmacy-specific contexts, creative digital pedagogy such as flipped e-learning models have shown promise. One study designed an interactive flipped e-learning (iFEEL) module for pharmacy students during the COVID-19 pandemic and reported positive learning outcomes, indicating that well-designed digital interventions can support pharmacy education effectively (Shahba et al., 2022).

Although a few studies captured the experiences of Iraqi pharmacy students during the COVID-19 crisis, follow-up research examining how those perceptions have evolved beyond the emergency period is scarce, highlighting a gap in post-pandemic understanding of students' attitudes toward online learning in Iraq (Mohammed, Rashid, and Abbas, 2023).

This study aims to fill that gap by exploring perceptions and attitudes of advanced pharmacy students in Iraq toward online learning, paying close attention to differences between urban and rural students, preferences for learning formats, and concerns around practical training. The goal is to contribute evidence that can guide well-grounded, culturally sensitive blended learning strategies in Iraqi pharmacy education.

2. Methods

2.1. Study design and setting

A descriptive cross-sectional survey design was employed to assess the perceptions and attitudes of advanced pharmacy students toward online learning in Iraq. The study targeted fourth- and fifth-year students enrolled in pharmacy colleges across multiple Iraqi governorates, representing both urban and rural areas. Data collection was conducted between October 2024 and January 2025.

2.2. Participants and sampling

Eligible participants were undergraduate pharmacy students aged 21 years or older, enrolled in the fourth or fifth academic year at the time of data collection. A non-probability sampling method was used, combining convenience and snowball techniques. The survey link was disseminated through official university communication channels, academic messaging groups on Google Classroom. Initial participants were encouraged to share the survey link with classmates to broaden participation. Participation was voluntary, and no incentives were offered.

2.3. Survey instrument

The questionnaire was structured into three main sections:

1. Demographic and Contextual Information: Items collected information on gender, age, academic year, university, area of residence (urban or rural), ownership and primary type of device used for online learning (personal computer (PC) or smartphone), and prior experience with online or blended courses. Respondents were also asked to indicate their preferred mode of learning (fully online, hybrid, or fully face-to-face) and to provide open-ended reasons for their choice.
2. Perception Scale: Perceptions toward online learning were measured using a 14-item, five-point Likert scale (0 = strongly disagree to 4 = strongly agree), adapted from the *Dundee Ready Educational Environment Measure (DREEM)* (Vaughan et al., 2014) and an online learning perception tool developed by Chakraborty et al. (2021). Items addressed dimensions such as clarity of content delivery, interaction with instructors, motivation to learn, and perceived adequacy of online formats for different types of coursework. The total score ranged from 0 to 56, with higher scores indicating more positive perceptions. Adaptation involved content review by three pharmacy education experts to ensure contextual relevance, followed by forward–backward translation into Arabic and reconciliation by a bilingual panel. A pilot test with 20 students was conducted to evaluate clarity, comprehensibility, and internal consistency. The Cronbach's alpha coefficient for the perception scale in the pilot was 0.706.
3. Attitude Scale: Attitudes toward online learning were assessed using an 11-item, three-point Likert scale (0 = disagree, 1 = neutral, 2 = agree),

adapted from Mamattah (2016). Items explored willingness to continue online learning in the future, perceived novelty of online education, and concerns related to skill development and employability. The maximum possible score was 22, with higher scores indicating more positive attitudes. Cronbach's alpha for the attitude scale in the pilot was 0.759.

The full questionnaire required approximately 8–10 minutes to complete and was formatted for both desktop and mobile devices to accommodate participants' varying levels of access.

2.4. Data collection procedure

The survey was administered online via Google Forms, selected for its accessibility, mobile compatibility, and ease of distribution in low-bandwidth environments. The introductory page outlined the study's purpose, assured participants of anonymity, and provided an electronic informed consent statement, which had to be acknowledged before proceeding. Only one submission per device was allowed to minimize duplicate responses.

2.5. Data management and analysis

Responses were downloaded into Microsoft Excel for initial cleaning and then imported into SPSS version 25 for statistical analysis. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarized demographic characteristics and scale scores. Independent-samples t-tests were used to compare mean perception and attitude scores between demographic subgroups, including gender, academic year, device ownership, primary learning device, and place of residence. Statistical significance was set at $p < 0.05$.

3. Results

3.1. Participant characteristics

A total of 386 pharmacy students completed the survey. The mean age was 22.76 years (SD = 2.12). Female respondents constituted 72.5% (n = 280), and 77.5% (n = 299) resided in urban areas. Fourth-year students represented 63.5% (n = 245) of the sample, with the remainder in their fifth year. Slightly over half of the participants (55.4%) owned a PC; however, only 18.9% reported using it as their primary learning device, with smartphones being predominant (81.1%). Most respondents (52.3%) preferred fully face-to-face (in-person) learning, followed by hybrid formats (25.9%) and fully online learning (21.8%) (Table 1).

Table 1. Demographic characteristics of pharmacy students.

Variable	N (%)
Gender	
Male	106 (27.5)
Female	280 (72.5)
Academic year	
4th year students	245 (63.5)
5th year students	141 (36.5)
Residence	
Urban	299 (77.5)
Rural	87 (22.5)
Have a PC	
Yes	214 (55.4)
No	172 (44.6)
Tool used for online learning	
PC	73 (18.9)
Smart Phone	313 (81.1)
University	
Baghdad	45 (11.7)
Mosul	95 (24.6)
Basra	7 (1.8)
Others	239 (61.9)
University support	
Agree	83 (21.5)
Neutral	190 (49.2)
Disagree	113 (29.3)
Preference of learning type	
I prefer fully online learning over face-to-face (in-person) learning	84 (21.8)
I like combination of both online and face-to face education (hybrid learning)	100 (25.9)
I am comfortable with the fully face-to-face over online learning	202 (52.3)

3.2. Learning preferences and reasons

Among those preferring in-person learning, the most frequently cited reasons included unstable internet connectivity and power supply (20.2%), unsuitability of online platforms for practical coursework (6.2%), and greater student–lecturer interaction in physical classrooms (18.1%). Students favoring online learning cited time savings and convenience (9.6%), recorded lectures for later review (4.4%), and avoidance of travel from remote areas (3.1%) as primary advantages. Hybrid learning supporters frequently suggested using online delivery for theoretical subjects and in-person sessions for practical or examination components (9.8%) (Table 2).

3.3. Perceptions toward online learning

Perception scores ranged from 4 to 47 out of a possible 56, with a mean score of 22.48 (SD = 8.50), indicating overall moderate perceptions. No individual item mean exceeded 3.5 on the 5-point scale, suggesting the absence of uniformly strong positive

Table 2. Reasons for learning mode preferences.

Preferred Mode	Reason	n (%)
In-person	Poor internet connection and frequent electricity outages made online learning difficult	78 (20.2)
In-person	Online learning doesn't work well for practical courses that require hands-on training	24 (6.2)
In-person	Online classes didn't adapt to different learning levels—everyone was taught the same way	27 (7.0)
In-person	Being in class allowed direct interaction with lecturers and peers	70 (18.1)
In-person	Prolonged screen time caused eye strain and other health concerns	2 (0.5)
Online	Saved time and allowed for social isolation, especially during the height of the pandemic	37 (9.6)
Online	Recorded lectures made it easier to review material and get feedback	17 (4.4)
Online	Helpful for students living far from their universities or in remote areas	12 (3.1)
Online	Chosen due to concerns about inadequate healthcare during the pandemic	20 (5.2)
Hybrid	Studying theory online while attending in-person sessions for exams worked best	61 (15.8)
Hybrid	Online for theory, in-person for practical, combined the best of both approaches	38 (9.8)

Table 3. Mean perception scores by demographic variables.

Variables	Mean ± SD	P-value
Gender		**0.001**
Males	24.9 ± 8.43	
Females	21.56 ± 8.35	
Academic year		0.554
4th year students	22.28 (8.38)	
5th year students	22.82 (8.71)	
Having a PC		0.214
Yes	22.96 (8.28)	
No	21.88 (8.75)	
Tool used for online learning		0.396
PC	23.24 (8.58)	
Phone	22.30 (8.48)	
Residence		**0.001**
Urban	21.73 (8.30)	
Rural	25.05 (8.69)	

*Student t-test.

responses. Males reported significantly higher perception scores than females (24.90 ± 8.43 vs. 21.56 ± 8.35; $p = 0.001$). Rural students also reported higher perceptions than urban students (25.05 ± 8.69 vs. 21.73 ± 8.30; $p = 0.001$). No statistically significant differences were observed by academic year, device ownership, or primary learning device (Table 3).

3.4. Attitudes toward online learning

Attitudes were generally mixed, with fewer than half of participants agreeing with statements reflecting strong enthusiasm for online education. Flexibility and accessibility were frequently acknowledged; however, a substantial proportion expressed reservations about the adequacy of online formats for practical skills and the potential disadvantage in the job market for graduates educated primarily online. Gender differences were the most consistent demographic influence on attitude scores, with males more likely to report favorable views on several items ($p < 0.05$).

Notably, 69.9% of respondents disagreed that online learning is suitable for courses requiring practical skills, and 57.0% feared reduced employment opportunities for graduates trained predominantly online. Conversely, 37.3% indicated they would consider using online learning for future studies (Table 4).

3.5. Demographic factors influencing attitudes

Analysis of attitude items by demographic characteristics revealed that gender differences were the most consistent and statistically significant across multiple statements. Male students were more likely than females to agree with positive statements about online learning, including enjoying the concept of online education (A1, $p < 0.01$), considering it a novel idea worth promoting (A2, $p < 0.01$), and finding the experience enjoyable (A3, $p < 0.01$).

Differences by place of residence were less frequent but notable. Rural students were significantly more likely to indicate willingness to use online learning for future studies (A11, $p < 0.05$) and to have been encouraged by others to try online learning (A5, $p = 0.015$).

Device type and computer ownership showed limited associations. Students using personal computers as their primary learning device were more inclined to express interest in employing online learning in the future (A11, $p = 0.021$), while ownership of a personal computer was associated with greater agreement on having been advised to attempt online study (A5, $p = 0.015$).

Academic year did not appear to significantly influence attitudes for most items. Overall, the data suggest that attitudes toward online learning are shaped more strongly by gender and, to a lesser extent, by residence and device-related factors (Table 5).

4. Discussion

This study examined the perceptions and attitudes of advanced (4th and 5th years) pharmacy students in Iraq toward online learning, with attention to demographic differences and preferred modes of instruction. The findings show that, while a notable proportion of students acknowledged the flexibility

Table 4. Frequencies of responses to attitude items.

Item	Statement	Disagree, n (%)	Neutral, n (%)	Agree, n (%)
A1	I really enjoy the idea of studying online	131 (33.9)	103 (26.7)	152 (39.4)
A2	Online learning is a fresh approach that should be encouraged	126 (32.6)	141 (36.5)	119 (30.8)
A3	Using online learning platforms felt enjoyable	133 (34.5)	130 (33.7)	123 (31.9)
A4	A family member thinks online learning is a good idea	109 (28.2)	104 (26.9)	173 (44.8)
A5	Someone advised me to give online studying a try	126 (32.6)	116 (30.1)	144 (37.3)
A6	I've heard from someone who tried online learning and liked it	126 (32.6)	119 (30.8)	141 (36.5)
A7	Someone I know said online learning was difficult to use	187 (48.4)	102 (26.4)	97 (25.1)
A8	I've read in the news that online learning can be beneficial	122 (31.6)	158 (40.9)	106 (27.5)
A9	Online learning doesn't work well for courses that require hands-on practice	270 (69.9)	70 (18.1)	46 (11.9)
A10	I worry that graduates from online programs might have a harder time finding jobs	220 (57.0)	122 (31.6)	44 (11.4)
A11	I'd consider using online learning for my studies in the future	120 (31.1)	122 (31.6)	144 (37.3)

and convenience of online learning, the majority continued to prefer fully face-to-face learning model. This preference was primarily driven by concerns over inadequate infrastructure, limited interaction with instructors, and the perceived inability of online platforms to adequately support practical skill acquisition.

The overall perception of online learning among pharmacy students in this study was moderate, a finding echoed in similar settings across low- and middle-income countries, where the sudden shift to digital education during the pandemic revealed deep-rooted challenges in infrastructure and teaching practices (Abbasi et al., 2020). Students in Iraq, like their peers in other Gulf and South Asian nations, recognize the benefits of flexibility and time savings that online learning offers (Mohammed, Rashid, and Abbas, 2023; Elnour et al., 2023; Cariaga, 2024). Yet, many remain cautious, particularly about whether virtual platforms can truly support hands-on training, a concern strongly reflected in our finding that over half still prefer face-to-face classes. This preference appears stronger than in recent studies from the Philippines and Saudi Arabia, where hybrid models have gained more traction (Paneerselvam et al., 2024; Balakrishnan et al., 2021). The difference may stem from Iraq's ongoing struggles with internet reliability, electricity outages, and limited institutional experience in creating engaging online content, factors that likely shape student confidence.

One of the most interesting findings was that rural students reported more positive perceptions of online learning than their urban counterparts, a reversal of what's been seen in places like South Africa and India, where rural students often face worse connectivity (Lembani et al., 2020; Muthuprasad et al., 2021). In Iraq, this might be because rural students stand to gain the most from avoiding long, costly commutes to urban universities. For them, online learning isn't just convenient, it can be a lifeline. In contrast, urban students, who often live near campuses and have easier access to labs and lectures, may see fewer advantages in switching online. This suggests that access to education isn't just about internet speed, it's also about geography, cost, and opportunity. As such, future blended learning strategies should consider not just technology, but also the real-life burdens students face in getting to class.

The overwhelming reliance on smartphones as the primary tool for online learning, reported by 81.1% of students in our sample, reflects a broader global shift toward mobile learning, particularly in regions where internet access is more stable on personal devices than on desktop computers (Cariaga, 2024; Mercan, Selçuk, and Kaya, 2024). This trend is especially pronounced in low- and middle-income countries, where smartphones often serve as the only affordable and portable gateway to digital education (Rustagi and Gautam, 2013). However, this pattern stands in contrast to findings from Europe and North America, where students more commonly use laptops or desktops, allowing for deeper interaction with complex course materials and multimedia platforms (Cariaga, 2024).

Attitude data further reinforced these concerns, with a clear majority expressing doubts about the suitability of online formats for practical courses and apprehension regarding future employability if trained primarily online. Gender emerged as the most consistent demographic factor influencing attitudes, with male students showing greater openness toward online education across several measures. While the reasons for this difference were not explored in the present study, previous research has suggested that variations in technology confidence, prior exposure, and social expectations may play a role (Abbasi et al., 2020).

Collectively, these findings highlight that online learning cannot be treated as a one-size-fits-all solution, especially in a field like pharmacy, where hands-on training is non-negotiable. While students in our study appreciated the flexibility of digital formats, their reservations about practical skill development and employability point to a deeper need: not

Table 5. Demographic factors influencing attitudes.

	Gender		Academic year		Having PC		Tools used		Residence	
Question	Male	Female	4th year	5th year	Yes	No	PC	Smartphone	Urban	Rural
A1	**P < 0.01**		P = 0.653		P = 0.373		P = 0.975		**P = 0.028**	
Disagree	**49(46.2)**	**82(29.3)**	79(32.2)	52(36.9)	78(36.4)	53(30.8)	24(32.9)	107(34.2)	**92(30.8)**	**39(44.8)**
Neutral	**33(31.1)**	**70(25.0)**	67(27.3)	36(25.5)	58(27.1)	45(26.2)	20(27.4)	83(26.5)	**80(26.8)**	**23(26.4)**
Agree	**24(22.6)**	**128(45.7)**	99(40.4)	53(37.6)	78(36.4)	74(43.0)	29(39.7)	123(39.3)	**127(42.5)**	**25(28.7)**
A2	**P < 0.01**		P = 0.478		P = 0.083		P = 0.951		P = 0.197	
Disagree	**48(45.3)**	**78(27.9)**	75(30.6)	51(36.2)	80(37.4)	46(26.7)	24(32.9)	102(32.6)	94(31.4)	32(36.8)
Neutral	**39(36.8)**	**102(36.4)**	94(38.4)	47(33.3)	73(34.1)	68(39.5)	28(38.4)	113(36.1)	106(35.5)	35(40.2)
Agree	**19(17.9)**	**100(35.7)**	76(31.0)	43(30.5)	61(28.5)	58(33.7)	21(28.8)	98(31.3)	99(33.1)	20(23.0)
A3	**P < 0.01**		P = 0.097		**P = 0.042**		P = 0.616		P = 0.055	
Disagree	**44(41.5)**	**89(31.8)**	77(31.4)	56(39.7)	**85(39.7)**	**48(27.9)**	28(38.4)	105(33.5)	96(32.1)	37(42.5)
Neutral	**39(36.8)**	**91(32.5)**	81(33.1)	49(34.8)	**69(32.2)**	**61(35.5)**	25(34.2)	105(33.5)	99(33.1)	31(35.6)
Agree	**23(21.7)**	**100(35.7)**	87(35.5)	36(25.5)	**60(28.0)**	**63(36.6)**	20(27.4)	103(32.9)	104(34.8)	19(21.8)
A4	**P < 0.01**		P = 0.347		P = 0.321		P = 0.427		P = 0.23	
Disagree	**39(36.8)**	**70(25.0)**	63(25.7)	46(32.6)	67(31.3)	42(24.4)	25(34.2)	84(26.8)	81(27.1)	28(32.2)
Neutral	**34(32.1)**	**70(25.0)**	68(27.8)	36(25.5)	56(26.2)	48(27.9)	19(26.0)	85(27.2)	77(25.8)	27(31.0)
Agree	**33(31.1)**	**140(50.0)**	114(46.5)	59(41.8)	91(42.5)	82(47.7)	29(39.7)	144(46.0)	141(47.2)	32(36.8)
A5	**P < 0.05**		P = 0.795		P = 0.085		P = 0.366		**P = 0.015**	
Disagree	**43(40.6)**	**83(29.6)**	80(32.7)	46(32.6)	72(33.6)	54(31.4)	26(35.6)	100(31.9)	**91(30.4)**	**35(40.2)**
Neutral	**34(32.1)**	**82(29.3)**	71(29.0)	45(31.9)	72(33.6)	44(25.6)	25(34.2)	91(29.1)	**85(28.4)**	**31(35.6)**
Agree	**29(27.4)**	**115(41.1)**	94(38.4)	50(35.5)	70(32.7)	74(43.0)	22(30.1)	122(39.0)	**123(41.1)**	**21(24.1)**
A6	P = 0.173		P = 0.478		P = 0.803		P = 0.874		P = 0.557	
Disagree	40(37.7)	86(30.7)	75(30.6)	51(36.2)	71(33.2)	55(32.0)	22(30.1)	104(33.2)	94(31.4)	32(36.8)
Neutral	35(33.0)	84(30.0)	76(31.0)	43(30.5)	63(29.4)	56(32.6)	23(31.5)	96(30.7)	92(30.8)	27(31.0)
Agree	31(29.2)	110(39.3)	94(38.4)	47(33.3)	80(37.4)	61(35.5)	28(38.4)	113(36.1)	113(37.8)	28(32.2)
A7	P = 0.159		P = 0.818		P = 0.836		P = 0.237		P = 0.656	
Disagree	43(40.6)	144(51.4)	118(48.2)	69(48.9)	105(49.1)	82(47.7)	32(43.8)	155(49.5)	146(48.8)	41(47.1)
Neutral	33(31.1)	69(24.6)	63(25.7)	39(27.7)	54(25.2)	48(27.9)	17(23.3)	85(27.2)	81(27.1)	21(24.1)
Agree	30(28.3)	67(23.9)	64(26.1)	33(23.4)	55(25.7)	42(24.4)	24(32.9)	73(23.3)	72(24.1)	25(28.7)
A8	P = 0.066		P = 0.056		P = 0.047		P = 0.862		P = 0.256	
Disagree	37(34.9)	85(30.4)	67(27.3)	55(39.0)	72(33.6)	50(29.1)	25(34.2)	97(31.0)	89(29.8)	33(37.9)
Neutral	49(46.2)	109(38.9)	105(42.9)	53(37.6)	94(43.9)	64(37.2)	29(39.7)	129(41.2)	123(41.1)	35(40.2)
Agree	20(18.9)	86(30.7)	73(29.8)	33(23.4)	48(22.4)	58(33.7)	19(26.0)	87(27.8)	87(29.1)	19(21.8)
A9	P < **0.05**		P = 0.051		P = 0.759		P = 0.198		P = 0.19	
Disagree	**64(60.4)**	**206(73.6)**	181(73.9)	89(63.1)	153(71.5)	117(68.0)	52(71.2)	218(69.6)	216(72.2)	54(62.1)
Neutral	**22(20.8)**	**48(17.1)**	36(14.7)	34(24.1)	37(17.3)	33(19.2)	9(12.3)	61(19.5)	50(16.7)	20(23.0)
Agree	**20(18.9)**	**26(9.3)**	28(11.4)	18(12.8)	24(11.2)	22(12.8)	12(16.4)	34(10.9)	33(11.0)	13(14.9)
A10	P < **0.05**		P = 0.271		P = 0.849		P = 0.116		P = 0.166	
Disagree	**51(48.1)**	**169(60.4)**	147(60.0)	73(51.8)	122(57.0)	98(57.0)	49(67.1)	171(54.6)	177(59.2)	43(49.4)
Neutral	**37(34.9)**	**85(30.4)**	71(29.0)	51(36.2)	66(30.8)	56(32.6)	16(21.9)	106(33.9)	92(30.8)	30(34.5)
Agree	**18(17.0)**	**26(9.3)**	27(11.0)	17(12.1)	26(12.1)	18(10.5)	8(11.0)	36(11.5)	30(10.0)	14(16.1)
A11	P < **0.05**		P = 0.073		P = 0.348		P = **0.021**		P = **0.226**	
Disagree	**47(44.3)**	**73(26.1)**	67(27.3)	53(37.6)	74(34.6)	46(26.7)	**29(39.7)**	**91(29.1)**	95(31.8)	25(28.7)
Neutral	**32(30.2)**	**90(32.1)**	78(31.8)	44(31.2)	70(32.7)	52(30.2)	**27(37.0)**	**95(30.4)**	88(29.4)	34(39.1)
Agree	**27(25.5)**	**117(41.8)**	100(40.8)	44(31.2)	70(32.7)	74(43.0)	**17(23.3)**	**127(40.6)**	116(38.8)	28(32.2)

just better technology, but smarter, more thoughtful teaching methods. This is where emerging tools like virtual simulations, interactive case-based learning, and AI-supported platforms could make a real difference. Though not yet widely used in Iraqi pharmacy education, such innovations, already shaping digital learning in other regions, offer promising ways to replicate clinical and laboratory experiences in a

virtual space (Weng and Zhang, 2025; Wang, Lee, and Mutlu, 2025; Ogunleye et al., 2024).

But technology alone won't bridge the gap. Our results show that student perceptions are shaped as much by context as by connectivity. For some, especially those in rural areas, online learning isn't just convenient, it's a lifeline. For others, particularly in cities with easier access to campuses, it may feel isolating or inadequate. This means that efforts to improve digital education must go beyond infrastructure. They should include targeted training for both students and faculty, mobile-optimized course design, and pedagogical models that blend the best of face-to-face interaction with the flexibility of online delivery. A truly effective blended approach isn't about replacing classrooms, it's about reimagining them in ways that are inclusive, practical, and grounded in the real challenges students face.

Several limitations should be considered when interpreting these findings. First, the use of a non-probability sampling strategy limits the generalizability of results, as participants may not fully represent the wider population of Iraqi pharmacy students. Second, data were self-reported and may be subject to social desirability bias. Third, while the survey was piloted and adapted from validated instruments, no confirmatory factor analysis was conducted to assess construct validity in the Iraqi context. Fourth, the study relied exclusively on quantitative measures; qualitative interviews or focus groups could have provided deeper insight into the reasons behind students' preferences and attitudes.

5. Conclusion

Pharmacy students in Iraq expressed moderate perceptions of online learning, with a strong preference for traditional face-to-face instruction. While flexibility and accessibility were valued, concerns regarding practical training and employability remain key barriers to wider acceptance of online formats. Rural students demonstrated more favorable perceptions than their urban counterparts, and smartphones were the predominant learning device.

Efforts to improve the effectiveness of online learning in pharmacy education should prioritize strengthening digital infrastructure, expanding faculty and student training in online pedagogy, and incorporating technology-enhanced methods to bridge gaps in practical skill acquisition. A well-designed hybrid model, tailored to local needs and resources, holds promise for balancing the flexibility of digital learning with the rigor of in-person clinical training.

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Conflict of interest

None

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