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*Original Article*

# Generative AI use, access channels, and perceptions among pharmacy students: A cross-sectional survey

[Uso de inteligencia artificial generativa, canales de acceso y percepciones en estudiantes de farmacia: una encuesta transversal]

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**Abstract**

*Context*: Pharmacy students use generative artificial intelligence (GenAI) through provider-operated, university-supported, and embedded channels, but curricular differences in access-channel choice remain poorly described.

*Aims*: To describe tools, access channels, perceived benefits and concerns, and unadjusted curricular-year differences among pharmacy students with prior GenAI experience.

*Methods*: A cross-sectional web survey recruited 180 Doctor of Pharmacy students by nonprobability quota sampling (30 per year). Primary access channels and 21 attitude items were assessed. Pearson-based exploratory factor analysis was complemented by a polychoric-matrix sensitivity analysis. Group differences and confidence intervals were estimated.

*Results*: ChatGPT was ranked as the most-used tool by 140/180 students (77.8%); 173/180 (96.1%) ranked at least two distinct tools among their three most-used. Provider-operated channels ranked first for 150/179 (83.8%), compared with 24/179 (13.4%) for the university portal. The portal was first-ranked by 19/90 later-year and 5/89 early-year students (odds ratio 4.50, 95% CI 1.60–12.65; Fisher exact p = 0.004). Pearson and polychoric factor analyses yielded two weakly correlated dimensions (r = 0.05 and 0.17, respectively). Perceived Benefits were higher in early-year students (4.42 vs. 4.18; mean difference 0.24, 95% CI 0.08–0.40), whereas Concerns did not differ significantly (p = 0.192).

*Conclusions*: In this selected sample of prior GenAI users at one pharmacy faculty, access-channel choice, daily use, and perceived benefits differed between curricular-year groups. The sampling method and cross-sectional design preclude population-level or developmental inferences.

*Keywords*: artificial intelligence; education, pharmacy; students, pharmacy; surveys and questionnaires.

**Resumen**

*Contexto*: Los estudiantes de farmacia utilizan inteligencia artificial generativa a través de plataformas de proveedores, portales universitarios y asistentes integrados. Las diferencias por curso entre canales están poco descritas.

*Objetivos*: Describir herramientas, canales, beneficios percibidos, preocupaciones y diferencias no ajustadas por curso entre estudiantes que habían utilizado IA generativa.

*Métodos:* Una encuesta transversal en línea incluyó a 180 estudiantes mediante un muestreo no probabilístico por cuotas (30 por curso). Se evaluaron los canales y 21 ítems de actitud. El análisis factorial basado en correlaciones de Pearson se complementó con un análisis de sensibilidad policórico. Se estimaron diferencias e intervalos de confianza.

*Resultados*: ChatGPT ocupó el primer lugar entre 140/180 estudiantes (77,8%); 173/180 (96,1%) clasificaron al menos dos herramientas distintas entre las tres más utilizadas. Los canales de proveedores ocuparon el primer lugar con 150/179 (83,8%) y el portal universitario, con 24/179 (13,4%). Este último fue primero para 19/90 estudiantes de cursos superiores (4.°–6.°) frente a 5/89 de cursos iniciales (1.°–3.°; odds ratio: 4,50; IC del 95 %: 1,60–12,65; prueba exacta de Fisher, p = 0,004). Se obtuvieron dos factores débilmente correlacionados (r = 0,05 y 0,17, respectivamente). Los beneficios percibidos fueron mayores en los cursos iniciales (4,42 frente a 4,18; diferencia: 0,24; IC del 95%: 0,08–0,40); las preocupaciones no difirieron significativamente (p = 0,192).

*Conclusiones*: En esta muestra de una sola facultad, los grupos difirieron en el canal principal, el uso diario y los beneficios percibidos. El muestreo y el diseño transversal impiden inferencias poblacionales y sobre cambios individuales.

*Palabras Clave*: educación en farmacia; encuestas y cuestionarios; estudiantes de farmacia; inteligencia artificial.

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**Abbreviations**: **AI**: Artificial intelligence; **aOR:** Adjusted odds ratio; **CI:** Confidence interval; **CROSS:** Checklist for Reporting of Survey Studies; **EFA:** Exploratory factor analysis; **GenAI:** Generative artificial intelligence; **IOC:** Item-objective congruence; **IQR:** Interquartile range; **KKU:** Khon Kaen University; **KMO**: Kaiser–Meyer–Olkin; **OR**: Odds ratio; **PAF:** Principal axis factoring; **SD**: Standard deviation.

## INTRODUCTION

Generative AI (GenAI) is increasingly used in health-profession education. A systematic review of 33 studies found that students used GenAI for practice, inquiry, content production, and acquiring information, while reporting benefits related to efficiency and access alongside concerns about critical thinking, academic integrity, and peer interaction (Pham et al., 2025). In a survey of 2,009 pharmacy students across nine countries, ChatGPT was the most-used tool, and perceived usefulness strongly correlated with acceptance (Elnaem et al., 2025). Other surveys of pharmacy and university students have described frequent use and generally favorable attitudes, tempered by concerns about inaccurate responses, invented references, and over-reliance (Anderson et al., 2024; Chan & Hu, 2023; Hamid et al., 2023; Mudenda et al., 2025; Zawiah et al., 2023). Sallam et al. (2023) examined potential applications and limitations of ChatGPT in health-profession education in a descriptive study using author-developed prompts and expert-panel evaluation of the generated responses, while scoping reviews have documented the expanding pharmacy-education literature (Abdel Aziz et al., 2024; Mortlock & Lucas, 2024).

Many studies emphasize overall acceptance or individual attitude items, which may obscure the relationship between use, channel preference, and appraisal. Students may find GenAI useful for routine study tasks while remaining concerned about its accuracy. In the nine-country pharmacy survey, affordability and habitual integration were comparatively lower-rated aspects of adoption (Elnaem et al., 2025).

Three aspects remain insufficiently described in pharmacy education: how perceived benefits and concerns relate, how students rank access channels rather than only preferred AI tools, and how they rate AI assistance across different learning tasks.

These distinctions matter in pharmacy education, where convenient access to information must be balanced against accuracy, patient safety, and professional judgment (Cain et al., 2023; Weidmann, 2024). At Khon Kaen University, students can use provider-operated AI tools alongside a university portal offering access to several models within a six-year professional program. This study examined the tools students had used, their primary access channels, the exploratory structure of perceived benefits and concerns, and unadjusted differences across curricular-year groups. Task-specific perceived utility was examined as a secondary descriptive outcome.

## MATERIAL AND METHODS

### Design and reporting

A single-center, cross-sectional questionnaire survey was conducted, with three short open-ended items forming a descriptive content-analysis component. Reporting was informed by the Checklist for Reporting of Survey Studies (CROSS; Sharma et al., 2021) and principles of web-survey reporting (Eysenbach, 2004); the completed CROSS checklist is provided in Supplementary Table S1.

### Setting

The study was conducted in the six-year Doctor of Pharmacy program at Khon Kaen University, Thailand. Students could reach GenAI through provider websites or applications using personal or university-provisioned accounts, through the separate KKU IntelliSphere institutional multi-model portal, or through assistants embedded in other software. The university provided Gemini access through Google Workspace for Education; participants accessed it through the provider interface and therefore could not be distinguished from personally obtained provider access using the channel-ranking item. The institutional portal used university sign-in. The questionnaire did not identify account payment status, subscription type, or reasons for selecting any channel.

### Participants and sampling

The source population comprised 985 Doctor of Pharmacy students enrolled as of October 10, 2025: 178, 172, 161, 164, 149, and 161 students in years 1–6, respectively. Eligible participants had previously heard of and used at least one AI tool; the number meeting these criteria for each year was unavailable. An initial planning calculation used a 68.2% prevalence of previous AI experience, a 95% confidence level, and 7.5% absolute precision (Zawiah et al., 2023). Because previous AI use was an eligibility criterion, that calculation was not used to justify power for group comparisons or factor analysis. To allow comparisons across all six years within available recruitment resources, 30 volunteers were enrolled per year using nonprobability quota sampling (N = 180). No prospective power calculation or minimally important difference was specified for

the inferential comparisons. Overall estimates describe the unweighted sample.

### Instrument

The Thai questionnaire was developed using previous pharmacy-education AI surveys (Anderson et al., 2024; Hamid et al., 2023; Zawiah et al., 2023) and scale-development guidance (Boateng et al., 2018). It covered participant characteristics and eligibility, ranked tools and access channels, 21 five-point attitude items (15 benefit-oriented and six concern-oriented), and three open-ended questions. Three experts rated item relevance. Each assigned +1 to all 21 items, giving an item-objective congruence index of 1.00 for every item. A pilot involving 30 students who were excluded from the main sample yielded a preliminary Cronbach alpha of 0.87 for the full item set. Formal cognitive interviews were not conducted. An English translation of the questionnaire is provided in Appendix S1.

### Data collection

From December 8, 2025 to January 27, 2026, students were invited through notices posted at several faculty locations and year-specific student communication groups, including LINE. They read the study information and provided electronic consent before completing Google Forms (Google LLC, Mountain View, CA, USA) questionnaires reviewed by the Khon Kaen University Ethics Committee for Human Research. Names, student identification numbers, e-mail addresses, and other direct identifiers were not collected. Optional items could be left unanswered. Researchers monitored responses and manually closed each year-specific form after receiving 30 submissions. Counts of students who viewed the invitations, opened forms, or began without submitting were unavailable; therefore, a conventional response rate could not be calculated. No IP-based or participant-specific technical checks prevented duplicate submissions. Item 2.4 recorded up to three ranked AI tools used most frequently. The response format did not prevent the same tool from being selected more than once; distinct nonzero tool codes were counted once per participant. Item 2.3 recorded up to five ranked access channels, with unused positions permitted to remain blank. The first-ranked channel defined primary access (n = 179). Participants could select the same channel in different positions, and this occurred in 29 responses. Those responses were retained for the first-ranked analysis, with a sensitivity analysis excluding them. Website and application routes were combined within provider-operated, KKU IntelliSphere, and embedded-assistant categories. The measure could not distinguish personal provider accounts from university-provisioned Gemini access. A separate descriptive indicator recorded whether a university-portal route appeared anywhere in the rankings; it was not validated against platform usage records.

### Data analysis

Analyses were conducted using IBM SPSS Statistics, version 29 (IBM Corp., Armonk, NY, USA), with supplementary analyses in R, version 4.6.1 (R Foundation for Statistical Computing, Vienna, Austria; psych package, version 2.6.9). All 21 attitude items had complete data for the 180 participants; valid denominators were used for the one missing frequency and one missing first-ranked access channel. Perceived Benefits and Concerns scores were the means of their respective 15 and six items. Pearson correlation principal axis factoring (PAF) with direct oblimin rotation was used to explore the factor structure in SPSS; promax rotation was also examined as a sensitivity check. Sampling adequacy and factorability were examined using the Kaiser–Meyer–Olkin statistic and Bartlett's test. Continuous Pearson parallel analysis was performed in R by comparing observed eigenvalues with the 95th percentiles of 500 simulated independent normal datasets (random seed 2024; O'Connor, 2000).

For ordinal-data sensitivity analyses, a polychoric correlation matrix was estimated from the 21 five-category Likert items using the psych package in R (Holgado-Tello et al., 2010). Principal axis factoring with oblimin and promax rotation was applied to that matrix. Factor retention was checked separately through ordinal parallel analysis: 500 independent within-item permutations preserved the marginal response distribution of each item, and observed polychoric eigenvalues were compared with the 95th percentile of the corresponding null eigenvalues (random seed 2024). Both parallel-analysis approaches retained two factors. Pattern loadings, communalities, uniqueness, and floor/ceiling distributions were examined (Tables S2, S9, and S10). Cronbach's alpha and McDonald's omega were estimated separately for each domain from the main dataset. Factor structure and reliability were assessed in the same sample.

Years 1–3 and years 4–6 were grouped to compare students in the earlier phase of the program with those in later professional-training years. This grouping was used for descriptive cross-sectional comparisons, not to infer within-student progression. The main group comparisons concerned perceived benefits, concerns, and daily versus less-than-daily AI use. Portal-primary selection, analyses by individual year, adjusted logistic regression, and comparisons among task-specific scores were considered exploratory. Mean differences and Cohen's d were reported with 95% confidence intervals. Mann–Whitney tests and Spearman rank correlations provided nonparametric sensitivity checks.

Portal-primary choice was assessed using the Fisher exact test alongside Pearson's chi-square test.

An exploratory binary logistic model used portal-first ranking as the outcome (1 = KKU IntelliSphere website or app; 0 = another first-ranked channel). The predictors were entered simultaneously as curricular stage (1 = years 1–3; 2 = years 4–6), daily use (1 = daily; 0 = less than daily), and gender (1 = female; 0 = male). The stage coefficient therefore compares later with early years; less-than-daily use and male gender are the covariate reference categories. Two participants were excluded: one had missing use frequency and first-ranked channel, and one did not specify gender (complete-case N = 178; 24 events). Daily use was included as an engagement-related covariate for a conditional-association sensitivity analysis, not as an established confounder; it could also lie on an intermediate pathway. The model was not used to estimate a causal direct effect or to predict individual outcomes. Coefficients, convergence, sparse-cell counts, and fit statistics are reported in Tables S12A–S12C.

To assess the effect of repeated channel selections across ranking positions, the first-ranked choice was retained for the principal analysis, and the portal comparison was repeated after excluding the 29 respondents with repeated selections. For a post hoc family of four comparisons (Benefits, Concerns, daily use, and portal-primary choice), Holm-adjusted p-values were calculated as a multiplicity sensitivity analysis, not as prospectively defined confirmatory tests. Friedman tests with Kendall's W compared eight exploratory benefit-task scores and, separately, the six multi-item scores. Post hoc paired Wilcoxon tests compared the six multi-item task scores, with Holm adjustment for 15 pairwise tests; the 15 two-sided asymptotic tests and Holm adjustments were verified in R (stats::wilcox.test, without continuity correction). Year-specific findings were reported descriptively without inferring change within students. Two-sided p-values below 0.05 were considered statistically significant; exploratory adjusted analyses were interpreted alongside confidence intervals.

### Qualitative analysis

Thai responses were analyzed descriptively using conventional content analysis (Hsieh & Shannon, 2005). PP developed the codebook, which PS reviewed. PP and PS coded the same 155 beneficial-experience, 155 problematic-experience, and 70 recommendation responses separately. Discrepancies were discussed and resolved by consensus. Code-specific agreement between PP and PS was summarized before consensus discussions, separating agreement on code presence from agreement on code absence (Table S13A). The consensus codes were used for the final descriptive analysis. Curricular-year information was available on the coding sheets. Multiple codes could be assigned to a response. Quotations were checked against the Thai responses and translated into English. Prompt examples may have influenced the brief responses.

### Ethics

The study was reviewed by the Khon Kaen University Ethics Committee for Human Research and granted exemption from full review (approval no. HE682214; 19 November 2025). The committee reviewed the Google Forms questionnaire and its electronic informed-consent procedure. Participation was voluntary; no direct personal identifiers were requested or collected, and participants could leave optional questionnaire items unanswered. Electronic informed consent was obtained before participation. The study was conducted in accordance with the principles of the Declaration of Helsinki.

## RESULTS

### Participant characteristics

All 180 participants had previously used GenAI, with 30 students from each curricular year. There were 112 women, 67 men, and one participant who did not specify gender. The fixed year quotas differed from the population's year-specific proportions.

### Tools and access channels used

ChatGPT was ranked as the most-used tool by 140 students (77.8%), followed by Gemini (32, 17.8%). Of the 180 participants, 173 (96.1%) ranked at least two distinct AI tools among their three most-used (86/90 early-year and 87/90 later-year students). Provider-operated websites and apps ranked first for 150/179 participants (83.8%), KKU IntelliSphere for 24/179 (13.4%), and embedded assistants for 5/179 (2.8%). The institutional portal appeared in at least one ranking position for 159/180 (88.3%); this measure indicates a reported ranking, not independently verified use. Daily use was reported by 55/89 (61.8%) early-year and 36/90 (40.0%) later-year participants (Pearson $\chi^2(1) = 8.51$, $p = 0.004$). KKU IntelliSphere was ranked first by 5/89 (5.6%) and 19/90 (21.1%), respectively (OR later versus early 4.50, 95% CI 1.60–12.65; two-sided Fisher exact $p = 0.004$; Tables 1 and S8). After exclusion of the 29 cases with repeated channel selections, the portal-primary association remained similar (OR = 5.12, 95% CI 1.62–16.16; two-sided Fisher exact $p = 0.003$; Table S12).

**Table 1.** GenAI tools and access channels, overall and by curricular stage (overall N = 180).

| Variable, n (%) | Overall | Early years 1–3 | Later years 4–6 | p-value |
|---|---|---|---|---|
| At least two distinct tools among three ranked | 173/180 (96.1) | 86/90 (95.6) | 87/90 (96.7) | |
| ChatGPT as most-used tool | 140/180 (77.8) | 74/90 (82.2) | 66/90 (73.3) | |
| Institutional portal ranked at any position | 159/180 (88.3) | 77/90 (85.6) | 82/90 (91.1) | |
| Provider-operated channel as primary | 150/179 (83.8) | 81/89 (91.0) | 69/90 (76.7) | |
| Institutional portal as primary | 24/179 (13.4) | 5/89 (5.6) | 19/90 (21.1) | 0.004 |
| Daily use | 91/179 (50.8) | 55/89 (61.8) | 36/90 (40.0) | 0.004 |

Note. Values describe the unweighted quota sample. Tool diversity reflects up to three ranked tools (item 2.4); portal ranked at any position is not log-verified use. Primary-channel and frequency analyses each exclude one missing response (n = 179). Portal-primary p is two-sided Fisher exact (Pearson $\chi^2$ p = 0.002); daily-use p is Pearson $\chi^2$. Other rows were descriptive only.

**Table 2.** Structure and reliability of the attitude scale.

| Domain | Items | Cronbach's α | McDonald's ω |
|---|---|---|---|
| Perceived benefits | 15 | 0.901 | 0.902 |
| Concerns | 6 | 0.803 | 0.799 |

Pearson-based PAF with oblimin (N = 180): KMO = 0.857; Bartlett $\chi^2(210) = 1710.60$, $p < 0.001$; variance explained = 41.5%; factor r = 0.050. Polychoric sensitivity: Tables S9–S10.

**Table 3.** Perceived Benefits and Concerns by curricular-stage group, with precision estimates.

| Domain | Early years 1–3, mean ± SD (N = 90) | Later years 4–6, mean ± SD (N = 90) | Mean difference | 95% CI, mean difference | t (df = 178) | p-value | Cohen d (95% CI) |
|---|---|---|---|---|---|---|---|
| Perceived benefits | 4.420 ± 0.551 | 4.181 ± 0.542 | 0.239 | 0.078 to 0.400 | 2.935 | 0.004 | 0.438 (0.141 to 0.733) |
| Concerns | 4.126 ± 0.779 | 3.980 ± 0.718 | 0.146 | −0.074 to 0.367 | 1.310 | 0.192 | 0.195 (−0.098 to 0.488) |

Note: independent-samples t tests with 95% confidence intervals; exploratory comparisons in a non-probability quota sample.

## Exploratory factor structure

Pearson-based PAF yielded two factors (KMO = 0.857; Bartlett $\chi^2(210) = 1710.60$, $p < 0.001$) that explained 41.5% of the variance and comprised 15 benefit-oriented and six concern-oriented items. Cronbach's alpha was 0.901 for Perceived Benefits and 0.803 for Concerns; McDonald's omega was 0.902 and 0.799, respectively. The Pearson factor correlation was 0.050 with direct oblimin and 0.048 with promax rotation, while the observed domain-score correlation was r = 0.062 (95% CI −0.085 to 0.207). Polychoric PAF in R recovered the same item grouping (51.1% of total standardized item variance accounted for; oblimin factor correlation 0.168). A separate ordinal parallel analysis also retained two factors (Tables 2, S2, S3, S9, and S10).

## Differences by curricular stage

Perceived Benefits were higher in early- than later-year participants (4.420 vs. 4.181; mean difference 0.239, 95% CI 0.078–0.400; t(178) = 2.935, p = 0.004; Cohen d = 0.438, 95% CI 0.141–0.733). Concerns did not differ significantly (4.126 vs. 3.980; difference 0.146, 95% CI −0.074 to 0.367; t(178) = 1.310, p = 0.192; d = 0.195, 95% CI −0.098 to 0.488). Across six years, Spearman rho was −0.352 ($p < 0.001$) for Benefits and −0.223 (p = 0.003) for Concerns; year-specific means were not monotonic and are presented in Table S8. After adjustment for daily use and gender, later-year status remained associated with portal-first ranking (aOR = 3.70, 95% CI 1.28–10.75; p = 0.016; n = 178; Table S12A). Holm-adjusted p-values for the selected exploratory family were 0.014 for Benefits, daily use, and portal-primary choice; Concerns remained nonsignificant (Table 3; Table S11).

## Perceived utility across learning tasks

Perceived utility was highest for language and writing (mean 4.57) and lowest for clinical-skills simulation (3.85). Two of the eight task scores were based on

single items. The Friedman test suggested small differences ($\chi^2(7) = 171.47$, $p < 0.001$; Kendall's W = 0.136), also observed when restricting the analysis to six multi-item task scores ($\chi^2(5) = 112.36$, $p < 0.001$; W = 0.125). Of 15 exploratory paired Wilcoxon comparisons among the six multi-item scores, 10 had Holm-adjusted $p < 0.05$ (Tables S14 and S15).

### Student experiences and recommendations

Analysis of open-ended responses included 155 accounts of beneficial experiences, 155 accounts of problems, and 70 responses to the recommendations question. Time saving or speed was the most frequent beneficial theme (79/155, 51.0%), followed by summarization and explanation or understanding (51/155, 32.9% each). In reports of problems, inaccurate information was most frequent (88/155, 56.8%), followed by unreliable references (47/155, 30.3%) and fabricated information (30/155, 19.4%). Among the recommendation responses, 29/70 (41.4%) were coded under AI integration and use in learning, 17/70 (24.3%) concerned AI as a teaching aid, and 15/70 (21.4%) concerned verification of AI-generated information. Multiple codes could be assigned to one response; six recommendation responses had no matching theme. Representative quotations and the descriptive joint display are provided in Tables S4–S7.

## DISCUSSION

Provider-operated channels were most frequently ranked first by participating students who had previously used GenAI. Participants rated many study-related tasks as useful while also expressing concern. Unadjusted differences were observed between early- and later-year groups.

### Perceived benefits and concerns

The questionnaire yielded two weakly correlated exploratory dimensions in both Pearson and polychoric analyses. This pattern may partly reflect the distinct wording and content of the 15 benefit-oriented and six concern-oriented items. High internal consistency and low factor correlations do not, by themselves, establish construct validity or intrinsic independence. Independent samples, balanced item wording, and ordinal confirmatory methods are needed for further validation (Boateng et al., 2018; Flora & Curran, 2004).

### Tools and access channels

Provider-operated websites and apps included personal accounts and university-provisioned Gemini credentials, which the ranking item could not distinguish. KKU IntelliSphere was first-ranked by 24 of 179 students and appeared at any position in 159 of 180 rankings. These descriptive results were not verified against institutional platform logs; no such logs were available for this study. The questionnaire did not ask why students preferred a particular channel. Platform features and access arrangements may be explored in future studies, but their effects cannot be inferred here. Embedded assistants were rarely ranked first (5/179), although this does not rule out supplementary use.

### Task-specific utility

Clinical-skills simulation was rated lower than the other broad task groupings, but this task was measured by only one item, so its precision and reliability are not comparable with multi-item task scores. The Friedman effect size (Kendall's W) was small and does not test which task category is more suitable or effective. Objective assessments of educational or clinical-task performance, rather than self-reported perceived utility, would be necessary to draw stronger conclusions (Huang et al., 2024; Nakagawa et al., 2022).

### Curricular-stage differences

Early-year students reported higher Perceived Benefits and more frequent daily use, whereas later-year students more often ranked the university portal first. Perceived Benefits could be more salient in earlier academic coursework, while later-year participants may differ in tasks and expectations; these interpretations were not directly tested. Although the two-group Concerns comparison was nonsignificant ($p = 0.192$), the six-year Spearman association was negative ($\rho = -0.223$, $p = 0.003$); the year-specific means were not monotonic (Table S8). These are comparisons among different students, not evidence of individual change. The adjusted portal association is conditional on daily use, which may be a mediator as well as an engagement marker; sparse events and unmeasured workload, prior instruction, subscriptions, and clinical exposure also limit interpretation.

### Comparison with other settings and implications

Reports from pharmacy and health-professions education describe frequent use of AI tools alongside concerns about accuracy and integrity (Elnaem et al., 2025; Mudenda et al., 2025; Pham et al., 2025; Zawiah et al., 2023). The present findings provide a descriptive account of first-ranked access routes within a quota sample, rather than demonstrating comparative effectiveness or adoption drivers. In education, transparent guidance on source checking, privacy, disclosure, professional judgment, and acceptable assistance should be evaluated in future studies. University provision may also affect access equity, an issue that could not be

investigated because payment and subscription data were not collected.

### Limitations

The single-center, nonprobability quota sample included only students with previous AI experience. The number of eligible students in each year and the number exposed to the invitation were unknown, preventing estimation of response rates or population prevalence. Repeated submissions could not be excluded technically. Tool and channel rankings were self-reported, and the indicator of an institutional portal ranked anywhere may overstate actual exposure when unused positions were filled; 150 students completed all five channel positions, and 29 repeated a channel across positions. Institutional platform usage logs were not available to verify responses. Provider-operated channels combined personal and university-provisioned access, and subscription status, workload, clinical exposure, and reasons for channel choice were not measured. The attitude instrument was assessed in the same sample used for scale scoring; item wording, ceiling effects, and the lack of cognitive interviewing or independent factor confirmation limit psychometric interpretation. Two task measures used single items. The brief open-ended prompts included examples that may have influenced answers, and relatively few students provided recommendations. Curricular-year information was present on the coding sheets, so blinding to year is not claimed. The cross-sectional design does not establish educational effectiveness or changes within students over time.

## CONCLUSION

Among 180 participating students with prior GenAI experience at one Thai pharmacy faculty, provider-operated channels were most commonly ranked first. A two-factor exploratory solution for Perceived Benefits and Concerns was recovered using Pearson and polychoric correlations. Early- and later-year participants differed in reported benefits, daily use, and first-ranked access channel. Independent validation and prospective studies are needed to clarify these associations and evaluate learning outcomes.

## CONFLICT OF INTEREST

The research was conducted entirely free from any involvement in commercial, financial, or personal matters that might be perceived as a possible conflict of interest or that could have influenced the outcomes or interpretation of the study.

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## GENERATIVE ARTIFICIAL INTELLIGENCE (AI)

During the preparation of this work, ChatGPT (OpenAI) was used to assist with language translation and to improve grammar and readability. Assistance with reviewer responses, analysis syntax, and document organization was also provided by the tool. All statistical analyses were independently executed and verified in SPSS and R by the authors. The source data and original Thai responses were cross-checked by the authors. Furthermore, all final coding and interpretation decisions were made by the authors. After using this tool, all output and content were reviewed, verified, and edited as needed by the authors. Full responsibility for the analyses and the publication's content is taken by the authors.

## DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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|---|---|---|---|---|---|
| Concepts or ideas | x | | | | x |
| Design | x | | | | x |
| Definition of intellectual content | x | | | | x |
| Literature search | x | x | x | x | x |
| Data acquisition | | x | x | x | |
| Data analysis | x | x | | | x |
| Statistical analysis | x | | | | x |
| Manuscript preparation | x | | x | x | |
| Manuscript editing | x | x | x | x | x |
| Manuscript review | x | x | x | x | x |

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## Supplementary data

**Table S1.** Completed CROSS reporting checklist. *Checklist for Reporting of Survey Studies (Sharma et al., 2021).*

| Item | Response | Location |
|---|---|---|
| **Title and abstract** | | |
| 1a | Study identified as a cross-sectional survey. | Title; Abstract |
| 1b | Structured abstract with Context, Objectives, Methods, Results, and Conclusions. | Abstract |
| **Introduction** | | |
| 2 | Background, existing evidence, and rationale for examining tool use, channel choice, and appraisal are presented. | Introduction |
| 3 | The study aim, specific objectives, and secondary descriptive aim are stated. | Introduction, final paragraph |
| **Methods** | | |
| 4 | Single-center, cross-sectional survey with a parallel set of open-ended items; reporting followed CROSS. | Material and Methods: Design and reporting |
| 5a | Questionnaire comprised four sections: demographics and prior AI experience; tool use and access-channel ranking; a 21-item attitude scale; and three open-ended questions. | Material and Methods: Instrument |
| 5b | Three-expert IOC = 1.00 for all 21 items; original Thai instrument, a 30-participant pilot with preliminary alpha .87, and the absence of formal cognitive interviews are described. Exploratory validation is explicitly limited. | Material and Methods: Instrument and Data analysis; Results: Exploratory factor structure; Table 2; Tables S2-S3 |
| 5c | A pilot of 30 excluded students was completed. Alpha .87 over all items is presented as a preliminary check, not evidence of unidimensionality. | Material and Methods: Instrument |
| 5d | English translation of the complete survey instrument is provided. | Appendix S1 |
| 6a | Eligible participants were Doctor of Pharmacy students in years 1–6 who had heard of and previously used at least one AI tool; pilot participants were excluded. | Material and Methods: Participants and sampling |
| 6b | Balanced quota sampling was used, with 30 students recruited from each curricular year. | Material and Methods: Participants and sampling |
| 6c | Balanced year-specific quotas yielded 180 cases; no prospective power calculation for EFA or between-stage comparisons. The earlier prevalence-based calculation is acknowledged as misaligned with these aims. | Material and Methods: Participants and sampling |
| 6d | The single-faculty setting, quota sampling, and limits to generalizability are acknowledged. | Discussion: Limitations |
| 7a | Open notices placed at multiple faculty locations and survey links disseminated through year-specific student channels and LINE. | Material and Methods: Data collection |
| 7b | Data were collected from 8 December 2025 to 27 January 2026. | Material and Methods: Data collection |
| 7c | Each year-specific form was closed manually after 30 submissions, yielding 180 submitted questionnaires. Counts of people viewing invitations or starting forms without submitting were not recorded. No IP, cookie, or participant-specific duplicate controls were used. | Material and Methods: Data collection |
| 8 | Questionnaire development, expert content review, pilot testing, online administration, year-specific distribution, and response caps are described. | Material and Methods: Instrument and Data collection |
| 9a | The study received exemption from full review (HE682214), and electronic informed consent was obtained before participation. | Material and Methods: Ethics and Data collection |
| 9b | Participation was voluntary and anonymous; no directly identifying data were collected. | Material and Methods: Data collection and Ethics |

**Table S1.** Completed CROSS reporting checklist. *Checklist for Reporting of Survey Studies (Sharma et al., 2021).*

| Item | Response | Location |
|---|---|---|
| 10a | Analyses included descriptive statistics, Pearson correlation PAF, continuous and ordinal parallel analyses, polychoric EFA sensitivity, alpha and omega reliability, chi-square and Fisher exact tests, odds ratios, t tests, Cohen's d, Mann–Whitney, Spearman, adjusted exploratory logistic regression, Holm adjustment, and Friedman tests with Kendall's W. Three open-ended items underwent descriptive content analysis; coding-file provenance and per-code raw agreement are documented in Tables S13–S13A. | Material and Methods: Data analysis and Qualitative analysis |
| 10b | The first-ranked tool and channel were classified as most-used tool and primary channel. Up to three distinct ranked tools were counted; KKU portal ranked at any position was a separate descriptive indicator. Channel access was grouped into provider-operated, institutional portal, and embedded assistants. Early years comprised 1–3 and later years 4–6. | Material and Methods: Data collection and Data analysis |
| 10c | All 21 attitude items were complete for 180 participants. One first-ranked channel and one use-frequency response were missing (valid n = 179). | Material and Methods: Data analysis; Results; Tables 1-3 |
| 10d | Non-response error could not be assessed because the numbers who viewed, opened, or began the survey were not recorded. | Material and Methods: Data collection |
| 10e | Not applicable because the study was cross-sectional. | Not applicable |
| 10f | No weighting; all overall values are unweighted sample descriptions rather than population estimates. | Material and Methods: Data analysis |
| 10g | Pearson-correlation PAF with oblimin rotation formed the main EFA. R-based polychoric PAF with oblimin and promax was used for ordinal-data sensitivity analysis; both continuous Pearson and permutation-based ordinal parallel analyses (500 replicates each) retained two factors. | Material and Methods: Data analysis; Results: Exploratory factor structure; Table 2; Tables S2-S3 |
| **Results** | | |
| 11a | A total of 180 eligible submissions were analyzed, with 30 participants from each curricular year. | Results: Participant characteristics |
| 11b | Pilot participants were excluded before the main survey. No completed eligible main-survey submissions were excluded from analysis. | Material and Methods: Participants and sampling; Results: Participant characteristics |
| 11c | A conventional response rate could not be calculated because the number invited or opening the survey was not recorded. The prespecified quota of 30 completed responses per year was achieved. | Material and Methods: Data collection; Results: Participant characteristics |
| 11d | Unique visitors and view, participation, and completion proportions were not recorded. | Material and Methods: Data collection |
| 12 | The tables report participant characteristics, distinct ranked tools, first-ranked and other channel rankings, attitudinal domains, comparisons by curricular year, and qualitative themes. | Results; Tables 1-3; Tables S4-S7 |
| 13a | Comparisons are reported with sample denominators, exact or asymptotic p-values as appropriate, confidence intervals, odds ratios, Cohen's d, Spearman ρ, and Kendall's W. | Results; Tables 1 and 3 |
| 13b | Core group comparisons were distinguished from exploratory or post hoc sensitivity analyses; adjusted logistic regression and Holm multiplicity checks were identified as exploratory. | Material and Methods: Data analysis; Results: Tools and access channels used and Differences by curricular stage |
| 13c | Missing data were minimal and handled using valid denominators and complete-domain scoring; no imputation was performed. | Material and Methods: Data analysis; Tables 1 and 3 |
| **Discussion** | | |
| 14 | Study limitations are explicitly reported. | Discussion: Limitations |
| 15 | Findings are interpreted cautiously, with educational implications distinguished from tested interventions. | Discussion; Conclusion |

**Table S1.** Completed CROSS reporting checklist. *Checklist for Reporting of Survey Studies (Sharma et al., 2021).*

| Item | Response | Location |
|---|---|---|
| 16 | External validity is addressed through discussion of the single-faculty setting, quota sampling, and eligibility restricted to prior GenAI users. | Discussion: Limitations |
| **Other sections** | | |
| 17 | No specific research grant supported this study. | Acknowledgment |
| 18 | Conflict of interest is declared. | Conflict of Interest |
| 19 | Acknowledgment of participating students is provided. | Acknowledgment |

**Table S2.** Parallel analysis: observed and random eigenvalues.

| Factor | Pearson observed | Normal null 95th | Polychoric observed | Ordinal null 95th | Retained (both) |
|---|---|---|---|---|---|
| 1 | 6.671 | 1.783 | 8.358 | 2.764 | Yes |
| 2 | 3.166 | 1.628 | 3.319 | 1.767 | Yes |
| 3 | 1.371 | 1.522 | 1.230 | 1.584 | No |
| 4 | 1.163 | 1.439 | 1.110 | 1.470 | No |
| 5 | 1.066 | 1.356 | 0.881 | 1.379 | No |
| 6 | 0.988 | 1.289 | 0.789 | 1.290 | No |

Continuous Pearson parallel analysis in R used the 21 complete five-point items (N = 180) and 500 simulated independent standard-normal datasets (random seed 2024). As an ordinal sensitivity check, R (psych 2.6.9) generated 500 independent within-item permutations of the same responses, preserving each item's observed marginal distribution. Polychoric correlations were estimated for the observed and permuted data, and each ordered eigenvalue was compared with the 95th percentile of its null distribution. Both procedures retained two factors (Table S2).

**Table S3.** Pattern matrix of the 21 attitude items.

| Item | Statement | Perceived benefits | Concerns |
|---|---|---|---|
| 3.1.1 | AI is useful for translating and understanding foreign-language content. | 0.47 | 0.01 |
| 3.1.2 | AI is useful for language editing, grammar, and spelling in academic documents. | 0.56 | 0.06 |
| 3.1.3 | AI is useful for summarizing key points of research or academic articles. | 0.68 | -0.04 |
| 3.1.4 | AI is useful for understanding or explaining complex content. | 0.64 | -0.05 |
| 3.1.5 | AI is useful for analyzing quantitative data (e.g., statistical data). | 0.62 | 0.10 |
| 3.1.6 | AI is useful for simulating scenarios to practice clinical skills (e.g., simulated patient/physician). | 0.63 | -0.03 |
| 3.1.7 | AI is useful for creating outlines or content for presentation slides. | 0.64 | 0.12 |
| 3.1.8 | AI is useful for exam preparation and review (e.g., predicting key topics, generating practice questions). | 0.63 | 0.08 |
| 3.1.9 | AI is useful for managing references and bibliographies. | 0.47 | -0.10 |
| 3.1.10 | AI is useful for searching for information of interest. | 0.52 | -0.10 |
| 3.2.1 | AI facilitates understanding of complex academic content. | 0.64 | 0.07 |
| 3.2.2 | AI helps summarize or organize key information from large sources (e.g., research articles, course content). | 0.67 | 0.06 |
| 3.2.3 | AI expands the scope of learning, allowing exploration of content not yet taught in the curriculum. | 0.77 | -0.01 |
| 3.2.4 | AI promotes critical thinking and evaluation of information. | 0.70 | -0.13 |
| 3.2.5 | AI improves the quality of academic work (e.g., grammatical accuracy, appropriate style, report structure). | 0.76 | 0.00 |
| 3.3.1 | I am concerned about the reliability of the information AI provides. | -0.12 | 0.67 |
| 3.3.2 | I am concerned that using AI may raise ethical issues, such as plagiarism. | -0.07 | 0.76 |
| 3.3.3 | I am concerned about over-relying on AI, hindering the development of my own critical-thinking skills. | -0.02 | 0.63 |
| 3.3.4 | I am concerned that using AI may involve additional costs. | 0.19 | 0.51 |
| 3.3.5 | I am concerned that faculty instructors may disapprove of students using AI. | 0.11 | 0.63 |
| 3.3.6 | I am concerned that using AI may lead to leakage of personal data. | -0.07 | 0.68 |

Pearson correlation PAF with direct oblimin rotation, listwise N = 180. KMO = 0.857; Bartlett $\chi^2(210) = 1710.60$, $p < 0.001$. Extracted variance = 41.5%; factor correlation = 0.050. Table entries are 21-item pattern coefficients from the revised Pearson analysis; polychoric-matrix sensitivity results are summarized in Table S9.

**Table S4.** Beneficial-experience themes (n = 155 respondents).

| Theme | Definition | n (%) | Representative quotation |
|---|---|---|---|
| Time saving/speed | AI saved time or sped up study tasks. | 79 (51.0%) | "Saves time, helps me understand things quickly, and allows me to ask questions I have no one else to ask." (B95) |
| Summarizing | AI condensed or summarized content. | 51 (32.9%) | "AI summarizes articles or difficult content so that it is easier to understand and helps me find references." (B86) |
| Explaining/understanding | AI explained or aided understanding of content. | 51 (32.9%) | "AI helps me understand material that the lecturer may not have explained, or that I still could not understand after the explanation." (B7) |
| Search/find info | AI helped search for or locate information. | 46 (29.7%) | "It helps extract keywords from papers and check what I might have missed after reading." (B72) |
| Language/translation | AI assisted with translation or language. | 22 (14.2%) | "It helps find information quickly and rephrase the wording." (B96) |
| Exam prep/practice | AI helped with exam preparation or practice questions. | 18 (11.6%) | "I use AI to simulate multiple-choice questions on examination topics and practice answering them." (B30) |
| Research/academic | AI supported research or academic articles. | 17 (11.0%) | "It helps me search for, select, and screen research articles relatively quickly." (B93) |
| Companion/assistant | AI served as a study companion or assistant. | 11 (7.1%) | "It helps me understand content I did not get from the lecturer, designs exercises, suggests ways to learn, and acts as a study companion." (B40) |
| Beyond-class learning | AI enabled learning beyond the curriculum. | 7 (4.5%) | "I can learn new skills quickly, such as software programs and coding." (B129) |

Descriptive content analysis of short Thai free-text responses. Theme counts and quotations are from the final classifications agreed during consensus discussions. More than one theme could be assigned to a response. All percentages use the 155 beneficial, 155 problematic, or 70 recommendation responses as appropriate and therefore may sum to more than 100%. Leading examples in the original prompts may have primed the responses.

**Table S5.** Problematic-experience themes (n = 155 respondents).

| Theme | Definition | n (%) | Representative quotation |
|---|---|---|---|
| Inaccurate/wrong | AI provided incorrect information. | 88 (56.8%) | "Retrieved information may be wrong and must be re-checked." (P2) |
| Unreliable references | AI gave unreliable or non-credible references. | 47 (30.3%) | "The information did not match the references provided, and some citations seemed fabricated." (P151) |
| Fabrication/hallucination | AI fabricated non-existent information. | 30 (19.4%) | "Some of the references seemed unreliable, or AI made information up." (P108) |
| Off-target/misunderstand | AI misunderstood or answered off-topic. | 17 (11.0%) | "It did not understand my instructions and answered off-topic; I needed to be more detailed." (P45) |
| Calc/processing errors | AI made calculation or processing errors. | 16 (10.3%) | "Sometimes it processed or calculated incorrectly and misinterpreted information." (P114) |
| Inconsistency | AI gave inconsistent or mixed information. | 14 (9.0%) | "ChatGPT mixed general internet content into a summary even though I had attached only one research paper." (P146) |
| Outdated/system limits | AI was outdated, slow, or had system limits. | 5 (3.2%) | "There are limits on how many images can be submitted; the website or app sometimes crashes." (P106) |
| Over-reliance/skill | Over-reliance may hinder skill development. | 4 (2.6%) | "Heavy use feels as though it slows down or reduces my own analytical ability." (P149) |
| Privacy | Concern about personal-data privacy. | 3 (1.9%) | "I am concerned about using real people's images for AI generation because of personal-data privacy." (P72) |

Codes were assigned to short Thai responses on the basis of the final coding. Several codes could apply to one response. Frequencies refer to the 155 retained responses about problems; quotations are translated excerpts of the original replies. Examples embedded in the question prompt may have shaped some answers.

**Table S6.** Recommendation themes (n = 70 respondents).

| Theme | Definition | n (%) | Representative quotation |
|---|---|---|---|
| AI integration and use in learning | Suggestions to incorporate AI into teaching and learning activities; requests for specific rules on acceptable use are classified separately under Clear boundaries. | 29 (41.4%) | "Learning should incorporate AI, but there should be caution about data security and copyright." (R56) |
| AI as teaching aid | Use AI as a teaching or learning aid or media. | 17 (24.3%) | "Lecturers could use AI to explain difficult material or as a simulated patient for students to practice dispensing." (R30) |
| Critical use/verify | Use AI critically and verify its outputs. | 15 (21.4%) | "Think critically before using information, and compare several sources to determine whether it is reliable." (R16) |
| Teach AI literacy | Teach students how to use AI. | 10 (14.3%) | "Teach students to use AI to create work, such as automation and AI agents for pharmacies and hospitals." (R57) |
| Ethics/responsibility | Address ethics; require references or responsible use. | 7 (10.0%) | "Students should use AI to support learning, not simply to do their work for them." (R25) |
| Clear boundaries | Set clear rules or limits for AI use. | 6 (8.6%) | "Lecturers should explain the limits of AI use in each course, including whether it can be used for writing reports." (R1) |
| Preserve instructor role | Preserve the instructor's role. | 3 (4.3%) | "AI can help with translation and organizing material, but should not generate the content being taught." (R15) |

Recommendations were analyzed from 70 responses to the recommendation item using the final coding decisions. More than one code could be applied to a response. Percentages are based on these 70 responses, not on all 180 participants. The wording of the prompt and the relatively small number of responses limit interpretation.

**Table S7.** Integrated joint display of quantitative and qualitative findings.

| Dimension | Quantitative finding | Student accounts | Interpretation |
|---|---|---|---|
| Tools | 173/180 (96.1%) ranked at least two distinct AI tools among their three most-used; ChatGPT ranked first (140/180, 77.8%). | Time saving (79, 51.0%), summarizing (51, 32.9%), explaining difficult content (51, 32.9%) | Many participants ranked more than one distinct tool for learning tasks |
| Channels | Provider-operated channel ranked first for 150/179 (83.8%); the institutional portal appeared at any rank for 159/180 (88.3%) and was ranked first for 24/179 (13.4%). | Not addressed directly in the open-ended items | Most students selected provider-operated websites or applications as their primary access channel. |
| Task profile | Highest for language and writing (4.57), lowest for clinical-skills simulation (3.85); Kendall's W = 0.136 | Inaccurate information (88, 56.8%), unreliable references (47, 30.3%) | The one-item clinical-simulation rating was lower descriptively; the small Friedman effect and unequal item counts prevent claims about task suitability or effectiveness. |
| Vigilance | Concerns 4.13 (years 1 to 3) and 3.98 (years 4 to 6); nearly uncorrelated with Perceived Benefits (r = 0.06) | Fabrication of content (30, 19.4%) | Favorable appraisal and concern coexisted rather than trading off |
| Curricular stage | Benefits 4.42 vs. 4.18 (t-test p = 0.004); daily use 61.8% vs. 40.0% (Pearson $\chi^2$ p = 0.004); portal primary 5.6% vs. 21.1% (OR 4.50, two-sided Fisher p = 0.004) | AI as a teaching aid (17, 24.3%); AI integration and use in learning (29, 41.4%). | Usage frequency, channel choice, and appraisal differed across curricular stages. |

This is a descriptive joint display. Association estimates are cross-sectional; qualitative comments did not directly elicit channel preferences. Quantitative analyses use the cleaned N = 180 data and portal and daily frequencies with item-specific N = 179.

**Table S8.** Main measures by year of study (n = 30 each).

| Year | N | Benefits mean | Concerns mean | Daily use (n/N) | Portal primary (n/N) | Portal ranked anywhere (n/N) | ChatGPT primary (n/N) |
|---|---|---|---|---|---|---|---|
| 1 | 30 | 4.627 | 4.183 | 23/29 | 4/29 | 27/30 | 22/30 |
| 2 | 30 | 4.478 | 4.272 | 16/30 | 0/30 | 28/30 | 27/30 |
| 3 | 30 | 4.156 | 3.922 | 16/30 | 1/30 | 22/30 | 25/30 |
| 4 | 30 | 4.298 | 4.206 | 18/30 | 6/30 | 28/30 | 21/30 |
| 5 | 30 | 4.249 | 3.867 | 10/30 | 9/30 | 29/30 | 18/30 |
| 6 | 30 | 3.996 | 3.867 | 8/30 | 4/30 | 25/30 | 27/30 |

The enrolled source population by curricular year (1–6) was 178, 172, 161, 164, 149, and 161 students, respectively (total N = 985, 10 October 2025). The balanced respondent quota was 30 in each year. These counts are enrollment totals, not denominators of students eligible by prior AI use. The unweighted sample results are not population prevalence estimates.

Unweighted group descriptions only. Denominators of 29 indicate the single missing primary-channel and frequency response in year 1; frequencies and portal choice were not corrected for nonprobability selection.

**Table S9.** Pearson versus polychoric EFA sensitivity.

| Measure | Pearson matrix | Polychoric matrix |
|---|---|---|
| Valid questionnaire responses | 180 | 180 (matrix based on complete item data) |
| Extraction | PAF; oblimin | PAF; oblimin (R psych::fa) |
| Factors imposed/retained | 2 retained (Pearson PA) | 2 retained (ordinal PA) |
| Total item variance accounted for | 41.5% | 51.1% |
| Inter-factor correlation | 0.050 | 0.168 |
| Main grouping | 15 Benefits; 6 Concerns | 15 Benefits; 6 Concerns |
| Cross-loadings ≥ 0.30 | None | None |
| Promax factor correlation | 0.048 | 0.232 |

Pearson correlation PAF with oblimin rotation and a promax sensitivity check was performed in SPSS Statistics 29. The ordinal-data sensitivity analysis used R 4.6.1 and psych 2.6.9: psych::polychoric calculated the item correlation matrix (global = FALSE; correct = 0.5), and psych::fa (fm = "pa") estimated two-factor solutions with oblimin and promax rotation. The reported polychoric results are based on the R analysis of the 180 complete responses. Ordinal parallel analysis based on 500 independently permuted within-item datasets retained two factors (Table S2). These results are exploratory and do not constitute independent confirmatory validation.

Total variance accounted for is 100 × the sum of extracted communalities divided by 21 items. For the oblique solutions, communalities incorporate correlations between factors.

**Table S10.** Item floor/ceiling percentages, polychoric pattern loadings, communalities, and uniqueness.

| Item | Floor (% at 1) | Ceiling (% at 5) | $h^2$, polychoric | Uniqueness | Benefits loading | Concerns loading |
|---|---|---|---|---|---|---|
| A_3_1_1 | 0.0 | 66.7 | 0.394 | 0.606 | 0.626 | 0.010 |
| A_3_1_2 | 0.6 | 62.2 | 0.501 | 0.499 | 0.688 | 0.085 |
| A_3_1_3 | 0.0 | 58.9 | 0.577 | 0.423 | 0.769 | -0.082 |
| A_3_1_4 | 0.0 | 59.4 | 0.546 | 0.454 | 0.747 | -0.058 |
| A_3_1_5 | 0.6 | 45.6 | 0.483 | 0.517 | 0.672 | 0.096 |
| A_3_1_6 | 1.7 | 31.1 | 0.433 | 0.567 | 0.664 | -0.044 |
| A_3_1_7 | 2.8 | 36.7 | 0.462 | 0.538 | 0.648 | 0.125 |
| A_3_1_8 | 1.7 | 47.8 | 0.487 | 0.513 | 0.681 | 0.078 |
| A_3_1_9 | 5.0 | 52.8 | 0.335 | 0.665 | 0.587 | -0.093 |
| A_3_1_10 | 0.6 | 60.0 | 0.451 | 0.549 | 0.680 | -0.072 |
| A_3_2_1 | 0.0 | 69.4 | 0.585 | 0.415 | 0.757 | 0.037 |
| A_3_2_2 | 0.0 | 64.4 | 0.622 | 0.378 | 0.762 | 0.111 |
| A_3_2_3 | 0.6 | 52.8 | 0.678 | 0.322 | 0.818 | 0.028 |
| A_3_2_4 | 2.2 | 38.9 | 0.542 | 0.458 | 0.747 | -0.151 |
| A_3_2_5 | 2.2 | 45.6 | 0.635 | 0.365 | 0.801 | -0.024 |
| A_3_3_1 | 0.6 | 53.9 | 0.541 | 0.459 | -0.060 | 0.743 |
| A_3_3_2 | 0.6 | 58.3 | 0.648 | 0.352 | -0.017 | 0.808 |
| A_3_3_3 | 1.1 | 61.7 | 0.481 | 0.519 | 0.043 | 0.685 |
| A_3_3_4 | 9.4 | 32.8 | 0.312 | 0.688 | 0.189 | 0.495 |
| A_3_3_5 | 2.8 | 34.4 | 0.446 | 0.554 | 0.112 | 0.640 |
| A_3_3_6 | 1.7 | 46.1 | 0.570 | 0.430 | -0.047 | 0.761 |

Floor and ceiling percentages are the proportions scoring 1 and 5 among the 180 respondents. Polychoric factor pattern coefficients, communalities, and uniqueness values are from the two-factor R psych::fa principal-axis solution with oblimin rotation; uniqueness equals 1 minus extracted communality. This is an exploratory measurement check.

**Table S11.** Exploratory inference and sensitivity summary.

| Comparison | Two-sided p | Holm-adjusted p |
|---|---|---|
| Portal primary (Fisher exact) | 0.004 | 0.014 |
| Daily use (Pearson chi-square) | 0.004 | 0.014 |
| Perceived benefits (t-test) | 0.004 | 0.014 |
| Concerns (t-test) | 0.192 | 0.192 |

Multiplicity correction was specified during revision for a post hoc family of four contrasts; it was not a prospective confirmatory family. Effect sizes are subject to sparse cells and unmeasured confounding.

**Table S12.** Additional sensitivity findings.

| Analysis | Estimate |
|---|---|
| Portal-primary: later versus early | OR 4.50 (95% CI 1.60–12.65); Fisher two-sided p = 0.004 |
| Adjusted portal-primary model | aOR 3.70 (95% CI 1.28–10.75), p = 0.016; n = 178 |
| Benefits: Mann–Whitney | p < 0.001 (SPSS output) |
| Concerns: Mann–Whitney | p = 0.088 (SPSS output) |
| Year versus Benefits: Spearman | ρ = −0.352, p < 0.001 |
| Year versus Concerns: Spearman | ρ = −0.223, p = 0.003 |
| Eight task groups: Friedman | $\chi^2(7) = 171.47$, p < 0.001; W = 0.136 |
| Six multi-item task groups: Friedman | $\chi^2(5) = 112.36$, p < 0.001; W = 0.125 |
| Portal-primary excluding duplicated rank categories | Rank 1 retained among n = 150 non-repeat responses; early 4/77 vs. later 16/73; OR 5.12 (95% CI 1.62–16.16); two-sided Fisher p = 0.003 (post hoc data-quality sensitivity; IBM SPSS Statistics 29) |

The portal-first logistic model used the coding specified in Methods and included 178 complete cases with 24 events. Stage was coded 1 = early and 2 = later. Archive records Q001 and Q047 were excluded for the reasons stated in Methods. The model converged in six iterations with finite coefficients and standard errors. Two of eight covariate patterns contained no events (Table S12B); convergence does not exclude sparse-data bias. No penalized regression or specialized separation test was performed. Goodness-of-fit and classification output are reported in Table S12C without claiming predictive validation. The ranking sensitivity excluded 29 repeated-channel responses and retained 150 records with a valid first-ranked channel; it was run in SPSS.

**Table S12A.** Complete exploratory logistic regression model (N = 178; 24 portal-first events).

| Term/comparison | B | SE | Wald $\chi^2$ | Adjusted OR (95% CI) | p-value |
|---|---|---|---|---|---|
| Stage: later vs. early | 1.309 | 0.544 | 5.794 | 3.703 (1.275–10.751) | 0.016 |
| Daily vs. less-than-daily | −1.363 | 0.541 | 6.350 | 0.256 (0.089–0.739) | 0.012 |
| Female vs. male | 0.236 | 0.483 | 0.238 | 1.266 (0.491–3.266) | 0.626 |
| Constant (stage coded 1/2) | −3.653 | 1.077 | 11.498 | 0.026 | <0.001 |

All predictors were entered simultaneously; each coefficient has 1 df. The stage coefficient compares codes 2 and 1. Stage was coded 1 = early and 2 = later; the constant corresponds to that coding.

**Table S12B.** Observed portal-first events by modeled covariate pattern.

| Stage | Use frequency | Gender | Other first rank | Portal first |
|---|---|---|---|---|
| Early | Less than daily | Male | 9 | 0 |
| Early | Less than daily | Female | 24 | 1 |
| Early | Daily | Male | 18 | 2 |
| Early | Daily | Female | 32 | 2 |
| Later | Less than daily | Male | 19 | 7 |
| Later | Less than daily | Female | 17 | 11 |
| Later | Daily | Male | 11 | 0 |
| Later | Daily | Female | 24 | 1 |

These are direct counts from the 178 records used in the existing model. Empty event cells and only 24 total events limit precision; no claim of absence of all sparse-data instability is made.

**Table S12C.** Convergence and model-fit output from the author-run SPSS analysis.

| Measure | SPSS output/interpretation |
|---|---|
| Convergence | 6 iterations; parameter changes <0.001 |
| −2 log likelihood | 123.720 |
| Omnibus likelihood-ratio test | $\chi^2(3) = 17.067$; $p < 0.001$ |
| Cox–Snell / Nagelkerke $R^2$ | 0.091 / 0.167 |
| Hosmer–Lemeshow test | $\chi^2(5) = 10.952$; $p = 0.052$ |
| Classification at threshold 0.50 | 154/154 non-events and 0/24 events classified correctly; overall 86.5% |
| Interpretation | No externally validated calibration or discrimination claim; the model estimates exploratory conditional associations. |

**Table S13.** Coding procedure and pre-consensus agreement.

| Element | Documented record |
|---|---|
| Response sets | Beneficial n = 155; problematic n = 155; recommendations n = 70. Multiple codes per response were permitted. |
| Coding roles | PP and PS coded the responses separately. PP developed the codebook, which PS reviewed. Both participated in consensus discussions. |
| Separate coding and year information | PP and PS coded separately before discussing discrepancies. Curricular-year information was available on the coding sheets. |
| Agreement comparison | PP versus PS before consensus; code-specific agreement on presence and absence is reported in Table S13A. |
| Consensus coding | Discrepancies were resolved through discussion. The agreed codes are labeled Consensus and were used for the final descriptive analysis. |
| Uncategorized responses | 4 beneficial, 2 problematic, and 6 recommendation responses had no assigned theme. |
| Privacy | Archive omits Thai verbatim text, English glosses, study year, and links to quantitative records from the shared coding tables. |

The coding records are labeled PP, PS, and Consensus. PP and PS contain the codes assigned separately before discussion; Consensus contains the codes agreed through discussion. Table S13A compares PP and PS before consensus, separating joint code presence from joint code absence. Consensus codes were used for the frequencies in Tables S4–S6. Curricular-year information was available on the coding sheets.

**Table S13A.** Code-specific agreement between PP and PS before consensus.

| Set | Code | Both + | PP only | PS only | Both − | Agreement |
|---|---|---|---|---|---|---|
| Beneficial | Time saving/speed | 71 | 0 | 8 | 76 | 147/155 |
| Beneficial | Summarizing | 45 | 0 | 6 | 104 | 149/155 |
| Beneficial | Explaining/understanding | 43 | 0 | 8 | 104 | 147/155 |
| Beneficial | Search/find info | 32 | 1 | 14 | 108 | 140/155 |
| Beneficial | Language/translation | 21 | 1 | 1 | 132 | 153/155 |
| Beneficial | Research/academic | 16 | 5 | 1 | 133 | 149/155 |
| Beneficial | Exam prep/practice | 16 | 1 | 2 | 136 | 152/155 |
| Beneficial | Beyond-class learning | 4 | 3 | 5 | 143 | 147/155 |
| Beneficial | Companion/assistant | 5 | 0 | 23 | 127 | 132/155 |
| Problematic | Inaccurate/wrong | 70 | 13 | 15 | 57 | 127/155 |
| Problematic | Unreliable references | 40 | 4 | 7 | 104 | 144/155 |
| Problematic | Fabrication/hallucination | 28 | 0 | 12 | 115 | 143/155 |

**Table S13A.** Code-specific agreement between PP and PS before consensus.

| Set | Code | Both + | PP only | PS only | Both − | Agreement |
|---|---|---|---|---|---|---|
| Problematic | Off-target/misunderstand | 10 | 2 | 7 | 136 | 146/155 |
| Problematic | Calc/processing errors | 10 | 1 | 6 | 138 | 148/155 |
| Problematic | Inconsistency | 7 | 0 | 7 | 141 | 148/155 |
| Problematic | Outdated/system limits | 5 | 1 | 0 | 149 | 154/155 |
| Problematic | Over-reliance/skill | 2 | 0 | 2 | 151 | 153/155 |
| Problematic | Privacy | 2 | 0 | 1 | 152 | 154/155 |
| Recommendations | AI as teaching aid | 21 | 1 | 9 | 39 | 60/70 |
| Recommendations | AI integration/use in learning* | 12 | 5 | 8 | 45 | 57/70 |
| Recommendations | Critical use/verify | 8 | 0 | 7 | 55 | 63/70 |
| Recommendations | Teach AI literacy | 6 | 1 | 4 | 59 | 65/70 |
| Recommendations | Ethics/responsibility | 5 | 1 | 2 | 62 | 67/70 |
| Recommendations | Clear boundaries | 2 | 0 | 4 | 64 | 66/70 |
| Recommendations | Preserve instructor role | 1 | 0 | 2 | 67 | 68/70 |

"Both +" and "Both −" indicate joint presence and joint absence. Agreement = [(Both +) + (Both −)] / N, where N is the number of responses. The denominators are 155, 155, and 70, respectively. Counts describe agreement before consensus; multiple code assignments within a response are not independent observations. *The earlier label "Embrace/reduce memorising" is mapped to the final reporting label without changing any classification. Across the binary code decisions, agreement was 1316/1395, 1317/1395, and 446/490 for the three response sets, respectively.

**Table S14.** Item structure and score distributions for exploratory task-specific benefits.

| Task domain | Items | Mean | Median | IQR (Q1–Q3) |
|---|---|---|---|---|
| Language/writing | 2 | 4.57 | 5.00 | 4.00–5.00 |
| Summarizing/understanding | 2 | 4.46 | 4.50 | 4.00–5.00 |
| Quantitative analysis | 1 | 4.21 | 4.00 | 4.00–5.00 |
| Clinical-skills simulation | 1 | 3.85 | 4.00 | 3.00–5.00 |
| Media/exam preparation | 2 | 4.09 | 4.50 | 3.50–5.00 |
| Search/references | 2 | 4.29 | 4.50 | 4.00–5.00 |
| Learning efficiency | 3 | 4.52 | 4.67 | 4.33–5.00 |
| Cognitive support | 2 | 4.03 | 4.00 | 3.50–5.00 |

All eight scores are presented descriptively. The median and interquartile range (IQR) are based on 180 complete responses. Scores from a single item are identified explicitly and are not assumed to have the same reliability as multi-item averages.

**Table S15.** Post hoc paired comparisons of the six multi-item benefit-task domains.

| Domain A | | Domain B | Raw p | Holm p |
|---|---|---|---|---|
| Language/writing | vs | Summarizing/understanding | 0.024 | 0.120 |
| Language/writing | vs | Media/exam preparation | <0.001 | <0.001 |
| Language/writing | vs | Search/references | <0.001 | <0.001 |
| Language/writing | vs | Learning efficiency | 0.137 | 0.411 |
| Language/writing | vs | Cognitive support | <0.001 | <0.001 |
| Summarizing/understanding | vs | Media/exam preparation | <0.001 | <0.001 |
| Summarizing/understanding | vs | Search/references | 0.037 | 0.148 |
| Summarizing/understanding | vs | Learning efficiency | 0.411 | 0.762 |
| Summarizing/understanding | vs | Cognitive support | <0.001 | <0.001 |
| Media/exam preparation | vs | Search/references | 0.004 | 0.023 |
| Media/exam preparation | vs | Learning efficiency | <0.001 | <0.001 |
| Media/exam preparation | vs | Cognitive support | 0.381 | 0.762 |
| Search/references | vs | Learning efficiency | <0.001 | 0.002 |
| Search/references | vs | Cognitive support | <0.001 | <0.001 |
| Learning efficiency | vs | Cognitive support | <0.001 | <0.001 |

Exploratory paired Wilcoxon signed-rank tests compared the six multi-item scores (15 unordered pairs; N = 180). The two-sided asymptotic p-values were verified in R 4.6.1 using stats::wilcox.test (paired = TRUE, exact = FALSE, correct = FALSE), with tied ranks handled by the rank-based approximation. Holm step-down adjustment was applied to the 15 comparisons using stats::p.adjust(method = "holm"). The original Friedman results (Kendall's W = 0.125 for the six multi-item domains) remain the global exploratory summary. Pairwise tests involving the two single-item scores were not conducted.

**Appendix S1.** Survey instrument (English translation).

The instrument was administered in Thai via Google Forms from 8 December 2025 to 27 January 2026. English translations are provided for reference and were not shown to participants.

**Sections 1 and 2.** General information and usage behavior

| Item | Question | Response options |
|---|---|---|
| 1.1 | Gender | Male; Female; Prefer not to specify |
| 1.2 | Year of study | Year 1; Year 2; Year 3; Year 4; Year 5; Year 6 |
| 1.3 | Have you previously heard of or known about AI? (including artificial intelligence, generative AI, machine learning, deep learning, chatbots, and large language models) | Yes; No |
| 1.4 | Have you previously tried any AI tools? (e.g., ChatGPT, Gemini, Claude, Meta AI, Nova (AWS), DeepSeek, Perplexity, Qwen, Mistral, Grammarly, Canva AI) | Yes; No |
| 2.1 | Which AI tools have you used? (select all that apply) | ChatGPT; Gemini; Claude; Perplexity; Meta AI; Nova (AWS); DeepSeek; Qwen/Alibaba Cloud; Mistral; Grammarly; Canva AI; Copilot; NotebookLM; xAI/Grok |
| 2.2 | How often do you use AI? | Daily; 2-3 times per week; Once a week; 1-2 times per month; Less than once a month |
| 2.3 | Rank the channels you use to access AI (rank 1 to 5) | Provider website/browser; provider application; KKU IntelliSphere website/browser; KKU IntelliSphere application; embedded assistant. Unused ranking positions could be left blank; the response format did not prevent the same channel from being selected in more than one position. |

**Sections 1 and 2.** General information and usage behavior

| Item | Question | Response options |
|---|---|---|
| 2.4 | Rank the AI tools you use most for learning (rank 1 to 3) | Same tool list as item 2.1; up to three ranked positions were recorded. Repeated selections were possible; only distinct nonzero tool codes were counted for the reported diversity measure. |

**Section 3.** Attitudes

Subsection 3.1 covers forms of AI use in learning; 3.2, benefits of AI for learning; and 3.3, concerns about AI use. Responses were rated on a five-point scale indicating the degree of agreement: 1 = lowest, 2 = low, 3 = moderate, 4 = high, and 5 = highest.

| Item | Variable | Statement |
|---|---|---|
| 3.1.1 | A_3_1_1 | AI is useful for translating and understanding foreign-language content. |
| 3.1.2 | A_3_1_2 | AI is useful for language editing, grammar, and spelling in academic documents. |
| 3.1.3 | A_3_1_3 | AI is useful for summarizing key points of research or academic articles. |
| 3.1.4 | A_3_1_4 | AI is useful for understanding or explaining complex content. |
| 3.1.5 | A_3_1_5 | AI is useful for analyzing quantitative data (e.g., statistical data). |
| 3.1.6 | A_3_1_6 | AI is useful for simulating scenarios to practice clinical skills (e.g., simulated patient/physician). |
| 3.1.7 | A_3_1_7 | AI is useful for creating outlines or content for presentation slides. |
| 3.1.8 | A_3_1_8 | AI is useful for exam preparation and review (e.g., predicting key topics, generating practice questions). |
| 3.1.9 | A_3_1_9 | AI is useful for managing references and bibliographies. |
| 3.1.10 | A_3_1_10 | AI is useful for searching for information of interest. |
| 3.2.1 | A_3_2_1 | AI facilitates understanding of complex academic content. |
| 3.2.2 | A_3_2_2 | AI helps summarize or organize key information from large sources (e.g., research articles, course content). |
| 3.2.3 | A_3_2_3 | AI expands the scope of learning, allowing exploration of content not yet taught in the curriculum. |
| 3.2.4 | A_3_2_4 | AI promotes critical thinking and evaluation of information. |
| 3.2.5 | A_3_2_5 | AI improves the quality of academic work (e.g., grammatical accuracy, appropriate style, report structure). |
| 3.3.1 | A_3_3_1 | I am concerned about the reliability of the information AI provides. |
| 3.3.2 | A_3_3_2 | I am concerned that using AI may raise ethical issues, such as plagiarism. |
| 3.3.3 | A_3_3_3 | I am concerned about over-relying on AI, hindering the development of my own critical-thinking skills. |
| 3.3.4 | A_3_3_4 | I am concerned that using AI may involve additional costs. |
| 3.3.5 | A_3_3_5 | I am concerned that faculty instructors may disapprove of students using AI. |
| 3.3.6 | A_3_3_6 | I am concerned that using AI may lead to leakage of personal data. |

**Section 4.** Open-ended questions

| Item | Prompt |
|---|---|
| 4.1 | A good or beneficial experience using AI (e.g., AI helped save time and learn faster). |
| 4.2 | A negative experience using AI (e.g., AI provided fabricated or non-existent information). |
| 4.3 | Suggestions for the faculty or instructors on using AI in teaching and learning. |