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A cognitive–motivational perspective on AI-assisted pre-clerkship preparation: a theory-informed cross-sectional study

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Abstract

Background

Artificial intelligence (AI) is increasingly integrated into medical education; however, its role in pre-clerkship preparation remains insufficiently understood, particularly in terms of underlying learning mechanisms. This study aimed to examine medical students' acceptance of an AI-assisted pre-clerkship preparation model and to test a theoretically informed pathway in which perceived usefulness drives behavioral intention, with potential implications for clinical readiness.

Method

A cross-sectional survey was conducted among 176 undergraduate medical students prior to their obstetrics and gynecology clerkship at a Chinese medical school between February and April 2026. The questionnaire assessed demographic characteristics, digital literacy, clerkship expectations, perceived usefulness, and behavioral intention. Analyses included descriptive statistics, correlation analyses, and multiple linear regression, guided by the Technology Acceptance Model.

Results

Students demonstrated moderate-to-high acceptance of AI-assisted pre-clerkship preparation (mean willingness 3.73 ± 0.70), with 63.0% expressing intention to participate. All dimensions of perceived usefulness showed strong correlations with behavioral intention (r = 0.787–0.846, all $p < 0.001$). In multivariable analysis, perceived usefulness (mean value of all dimensions) emerged as the only significant predictor (β = 0.866, $p < 0.001$), explaining 71.8% of the variance. Other factors, including academic performance and digital literacy, were not independently associated with behavioral intention after adjustment. Students preferred concise, structured, and case-based preparation formats.

Conclusions

Findings support a simplified Technology Acceptance Model in which perceived usefulness is the primary driver of students' engagement with AI-assisted pre-clerkship preparation. This model suggests that AI may enhance pre-clerkship learning by increasing behavioral engagement, thereby contributing to improved clinical readiness and addressing the pre-clinical cognitive scaffolding gap. Educational implementation should prioritize meaningful learning value and clinical relevance over technological complexity.

1. Background

Clinical clerkship represents a critical transition from theoretical knowledge acquisition to experiential clinical practice. However, in specialties such as obstetrics and gynecology, students frequently encounter structural barriers, including restricted patient access due to privacy concerns, limited opportunities for hands-on examination, and variability in clinical case exposure. These challenges often result in inadequate preparedness, impairing students' ability to translate foundational knowledge into effective clinical reasoning.

Recent advances in artificial intelligence (AI), particularly large language models (LLMs), have introduced new possibilities for medical education[1–4]. Emerging evidence suggests that AI can support knowledge acquisition, clinical reasoning[5–7], and simulation-based learning by providing interactive, adaptive, and context-specific guidance[8, 9]. Studies have demonstrated that AI-assisted tools can enhance diagnostic reasoning[10, 11], improve knowledge retention[12], and facilitate self-directed learning[13]. However, most existing applications focus on in-class instruction or clinical skills training, with relatively limited attention to the preparatory phase preceding clinical exposure.

Pre-clerkship preparation is increasingly recognized as a critical yet under-optimized stage of medical training. From the perspective of self-regulated learning and constructivist theory, effective preparation enables learners to activate prior knowledge, identify knowledge gaps, and construct preliminary cognitive frameworks before engaging in authentic clinical contexts[14, 15]. Without such preparation, students may experience cognitive overload and reduced learning efficiency during clerkship[16]. This deficiency may reflect a broader pre-clinical cognitive scaffolding gap[17], referring to the lack of structured mechanisms that support learners in organizing and activating knowledge prior to clinical engagement[18]. AI-assisted pre-clerkship preparation has the potential to address these challenges by enabling structured preview of clinical scenarios, guided question generation, and personalized knowledge organization[19–21].

Despite these theoretical advantages, the successful integration of AI into medical education depends fundamentally on learner acceptance. The Technology Acceptance Model (TAM) posits that perceived usefulness and perceived ease of use are primary determinants of users' behavioral intention[22–26]. While TAM has been widely validated in digital learning environments, its applicability in clinically contextualized, AI-supported pre-clerkship learning remains insufficiently explored. In particular, it is unclear whether perceived usefulness outweighs individual differences in digital literacy when students engage with AI tools for clinically oriented preparation.

Therefore, this study aimed to examine medical students' acceptance of an AI-assisted pre-clerkship preparation model within a real clinical education context. Guided by TAM, we further sought to identify key determinants of students' willingness to engage with AI-supported learning. We hypothesized that perceived usefulness would be the primary driver of behavioral intention, exceeding the influence of technical proficiency and prior digital experience.

2. Methods

2.1 Study Design and Participants

A cross-sectional survey was conducted among undergraduate medical students at Hangzhou City University prior to their obstetrics and gynecology clerkship between February and March 2026. Eligible participants were students who had not yet entered the clerkship and voluntarily provided informed consent.

A total of 192 questionnaires were collected. After excluding responses with incomplete data or evident logical inconsistencies, 176 valid questionnaires were included in the final analysis, yielding an effective response rate of 91.7%.

2.2 Questionnaire Development

The questionnaire was developed based on a review of the literature on technology acceptance and medical education, as well as the authors' prior teaching experience in obstetrics and gynecology clerkship. The questionnaire was originally developed in Chinese and translated into English using a conceptual equivalence approach.

Content validity was established through expert review by three specialists (two senior obstetrics educators and one medical education researcher). Minor revisions were made to improve clarity and relevance.

The final questionnaire consisted of 32 items across six domains. For the purpose of this study, 24 items that were directly aligned with the research objectives and theoretical framework were included in the analysis. Items not relevant to the key study variables were excluded.

Demographic and academic characteristics (5 items; Q2, Q3, Q5, Q6, Q7)

(e.g., gender, year of study, self-rated academic performance, theoretical course grades)

Digital literacy (3 items; Q8, Q18, Q19)

(e.g., confidence in using digital tools, familiarity with AI, use of medical databases)

Clerkship expectations (4 items; Q9, Q12, Q16, Q17)

(e.g., anticipated challenges, perceived preparedness)

Acceptance of AI-assisted pre-clerkship preparation (2 items; Q20, Q21)

(e.g., openness to AI-assisted learning, willingness to participate)

Perceived usefulness (5 items; Q22–Q26)

(e.g., improving understanding, enhancing clinical observation, facilitating communication, supporting lifelong learning, compensating for limited clinical exposure)

Implementation preferences (5 items; Q28–Q32)

(e.g., preferred timing, format, duration, and training support)

All Likert-scale items were rated on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

2.3 Reliability and Variable Construction

Internal consistency of the perceived usefulness scale (Q22–Q26) was assessed using Cronbach's alpha, which demonstrated excellent reliability (α = 0.977), indicating excellent internal consistency, although potential item redundancy cannot be excluded

A composite score for perceived usefulness was calculated as the mean of the five items and treated as a continuous variable in subsequent analyses.

Behavioral intention toward AI-assisted pre-clerkship preparation was operationalized using a single item (Q21), which specifically assessed students' willingness to actively participate in AI-assisted learning activities. In contrast, Q20 primarily reflected general acceptance and openness toward AI-assisted learning, which is conceptually closer to attitudinal perception rather than behavioral intention. Therefore, Q21 was selected as the behavioral indicator in alignment with the Technology Acceptance Model (TAM) framework. This operationalization is consistent with the TAM distinction between attitude and behavioral intention, where intention refers to the willingness to engage in actual system use or participation.

2.4 Theoretical Framework

This study was guided by the TAM, which posits that perceived usefulness is a primary determinant of behavioral intention (Fig. 1). Behavioral intention was operationalized using a single-item measure (Q21), which specifically captures willingness to engage, a construct shown to be more proximally related to behavior than general acceptance. Perceived ease of use was not included due to the exploratory focus on educational value.

In alignment with TAM, perceived usefulness was treated as the main independent variable, while behavioral intention served as the outcome variable. Additional variables, including demographic characteristics (gender, year of study), academic performance (self-rated academic performance, theoretical course grades), digital literacy (confidence in using digital tools, familiarity with AI, use of medical databases), and clerkship expectations (anticipated challenges, perceived preparedness), were included as potential influencing factors.

2.5 Statistical Analysis

All statistical analyses were performed using SPSS version 26.0.

Descriptive statistics were used to summarize participant characteristics and key variables. Pearson or Spearman correlation analyses were conducted as appropriate based on data distribution.

Univariate analyses were first performed to identify variables associated with behavioral intention. Variables with $P < 0.10$ were subsequently entered into a multiple linear regression model using the enter method to identify independent predictors.

Assumptions of linear regression, including normality, independence, and multicollinearity, were evaluated. The Durbin–Watson statistic was used to assess independence of residuals, and variance inflation factors (VIFs) were examined to detect multicollinearity.

A two-tailed P value < 0.05 was considered statistically significant.

3. Results

3.1 Participant characteristics

A total of 176 valid responses were included in the analysis (Supplementary Table 1). The sample was predominantly composed of fourth-year students (78.4%), with a balanced gender distribution (54.5% male, 45.5% female). Most participants reported good or above-average academic performance (65.9%) and theoretical course grades (64.2%).

Notably, only 4.0% of students expressed a clear intention to pursue obstetrics and gynecology, while the majority were either not interested (55.7%) or uncertain (40.3%).

In terms of digital literacy, most students reported moderate confidence (66.5%), and nearly half used AI tools on at least a weekly basis (47.2%). However, familiarity with medical databases (such as UpToDate, PubMed, and clinical guideline APP) remained limited, with only 10.2% reporting proficient use.

3.2 Clerkship expectations and perceived barriers

Most students reported neutral expectations toward the upcoming clerkship (66.5%), while 19.3% expressed some degree of concern (Table 1).

The most frequently anticipated challenges were structural in nature, including patient privacy restrictions (27.7%), insufficient theoretical preparation (27.5%), and limited or atypical clinical cases (23.2%). Together, these factors accounted for nearly 80% of all responses, highlighting systemic barriers that may constrain effective clinical learning.

Table 1
Students' expectations and perceived challenges

Item	Category	n (%)
Overall expectation of clerkship		
	Very concerned	6 (3.4%)
	Somewhat concerned	34 (19.3%)
	Neutral	117 (66.5%)
	Somewhat positive	15 (8.5%)
	Very positive	4 (2.3%)
Perceived challenges (multiple responses)		
	Patient privacy restrictions	124 (27.7%)
	Insufficient theoretical preparation	123 (27.5%)
	Limited or atypical cases	104 (23.2%)
	Lack of structured guidance	68 (15.2%)
	Inadequate teaching	29 (6.5%)

3.3 Acceptance of AI-assisted pre-clerkship preparation

Overall, students demonstrated moderate-to-high acceptance of AI-assisted pre-clerkship preparation (Supplementary Table 2). The mean score for openness to AI-assisted learning was 3.78 ± 0.68, while the mean willingness to participate was 3.73 ± 0.70.

In total, 67.6% of students expressed a positive attitude toward AI-assisted learning, and 63.0% indicated willingness to engage in such activities.

3.4 Perceived usefulness and behavioral intention

Given the study's theoretical focus on perceived usefulness, multivariable analysis results are presented as the primary findings, with univariate analyses provided as supporting evidence.

In univariate analyses, multiple variables—including perceived usefulness, academic performance, digital literacy, and clerkship-related factors—were significantly associated with behavioral intention (Supplementary Table 3–6).

Among these, all dimensions of perceived usefulness demonstrated strong and consistent correlations with behavioral intention ($r = 0.787–0.846$, all $P < 0.001$), with "improving understanding of disease knowledge" showing the strongest association.

3.5 Multivariable analysis of factors associated with behavioral intention

In multivariable regression analysis, perceived usefulness emerged as the only significant independent predictor of behavioral intention (β = 0.866, $P < 0.001$; Table 2), explaining 71.8% of the variance (adjusted $R^2 = 0.718$).

Variables that were significant in univariate analyses—including academic performance, theoretical grades, career intention, digital literacy, AI usage frequency, medical database familiarity, and clerkship-related concerns—were no longer significant after adjustment.

This pattern suggests that the influence of these variables on behavioral intention may be mediated through perceived usefulness.

Table 2
Multivariable Regression Analysis

Variable	Unstandardized coefficients		Standardized coefficients			Collinearity statistics	
	B	Standard error (SE)	β	t	*P* value	95% CI	VIF
(constant)	0.49	0.28		1.754	0.081		
Perceived usefulness (composite score)	0.173	0.010	0.866	18.113	< 0.001	0.705	1.418
Self-rated performance	-0.02	0.052	-0.21	-0.387	0.699	0.539	1.854
Theoretical grade	0.032	0.048	0.035	0.663	0.508	0.592	1.690
Career intention (OBGYN)	0.004	0.051	0.004	0.088	0.930	0.950	1.052
Digital literacy confidence	-0.007	0.050	-0.007	-0.140	0.889	0.690	1.450
AI usage frequency	0.077	0.046	0.077	1.702	0.091	0.780	1.282
Medical database familiarity	-0.026	0.041	-0.029	-0.640	0.523	0.791	1.263
Anticipated difficulty (theory-practice gap)	0.002	0.034	0.003	0.066	0.947	0.878	1.139
Opportunity restriction concern	-0.34	0.043	-0.038	-0.789	0.431	0.693	1.443
Model Summary:							
$R^2 = 0.732$							
Adjusted $R^2 = 0.718$							
$F = 50.40$, $p < 0.001$							
Durbin–Watson = 1.988							
Note: The perceived usefulness composite score was calculated as the mean of Q22–Q26 (Cronbach's α = 0.977).							

3.6 Implementation Preferences

Students demonstrated clear and pragmatic preferences for the design of AI-assisted pre-clerkship preparation (Table 3).

The most preferred timing for preparation was 2–3 days before clerkship (34.1%), followed by 4–7 days (30.1%). In terms of learning materials, students prioritized explicit learning objectives (50%) as the most

important component, followed by disease lists with guiding questions (35.3%), while virtual patient cases (36.5%) were more often ranked at lower priority levels (Fig. 2).

Regarding output formats, written summaries (33.6%) and concept maps (25.8%) were most favored. A strong preference for efficiency was evident, with 69.9% of students indicating that preparation tasks should be completed within 30 minutes.

In addition, most students expressed a need for lightweight support, including search strategies (31.0%), tool recommendations (30.0%), and tutorials (29.1%), while only 9.6% reported no need for training.

Table 3
Implementation Preferences

Category	n(%)
Preparation timing	
1 day before	15 (8.5%)
2–3 days before	60 (34.1%)
4–7 days before	53 (30.1%)
1 week before	48 (27.3%)
Preferred output format	
Written summary	86 (33.6%)
Concept map	66 (25.8%)
Group discussion	56 (21.9%)
Oral presentation	39 (15.2%)
Other	9 (3.5%)
Training needs	
Tool recommendations	94 (30.0%)
Tutorials	91 (29.1%)
Search tips	97 (31.0%)
No training needed	30 (9.6%)
Other	1 (0.3%)
Preferred duration	
< 30 min	123 (69.9%)
30–60 min	45 (25.6%)
> 1 hour	7 (4.0%)
> 2 hour	1 (0.6%)

4. Discussion

This study demonstrates that medical students are generally receptive to AI-assisted pre-clerkship preparation, with perceived usefulness emerging as the dominant determinant of engagement. As illustrated in Fig. 1, this finding supports a simplified TAM pathway in which perceived usefulness directly drives behavioral intention in a clinically contextualized learning environment[24–26].

Notably, perceived usefulness accounted for a substantial proportion of variance in behavioral intention, while variables such as digital literacy and academic performance were not independently significant after adjustment. This suggests that students' evaluation of learning value outweighs their technical proficiency. These findings challenge the common assumption that digital literacy is the primary barrier to AI adoption[27, 28] and instead highlight a value-driven adoption mechanism: students are more likely to engage with AI tools when they perceive clear relevance to clinical learning and performance.

From a theoretical perspective, this pattern can be interpreted through the lens of the pre-clinical cognitive scaffolding gap. As identified in the Introduction, students often enter clerkship without sufficient structured preparation to effectively organize and apply prior knowledge[29]. The strong association between perceived usefulness and behavioral intention suggests that AI-assisted pre-clerkship preparation may be most impactful when it addresses this gap by providing structured, cognitively supportive learning experiences[30]. In this context, perceived usefulness may reflect not only functional utility, but also the extent to which AI tools facilitate knowledge organization, reduce cognitive load, and support early-stage clinical reasoning[31].This prioritization reflects an implicit learning hierarchy from structured knowledge to applied reasoning.

Importantly, students' preferences for learning materials (Fig. 2) provide further insight into this mechanism. Students prioritized explicit learning objectives as the most important component, followed by disease lists with guiding questions, while case-based materials were more frequently ranked at lower priority levels. This pattern suggests that, prior to clinical exposure, learners place greater value on structured cognitive frameworks and guided knowledge organization than on complex, context-dependent scenarios[32, 33]. Such preferences are consistent with scaffolding theory, in which learners benefit from stepwise support that progresses from structured knowledge to applied reasoning[34]. Together, these findings reinforce the interpretation that AI-assisted pre-clerkship preparation is most effective when designed to support early cognitive structuring rather than premature immersion in clinical complexity.

From an educational perspective, these findings have several implications. First, the central role of perceived usefulness underscores the importance of aligning AI tools with authentic learning needs rather than focusing solely on usability or technical features. Second, the lack of association between digital literacy and engagement suggests that concerns regarding students' technical readiness may be overstated. Instead, instructional design—particularly the provision of concise, structured, and clinically relevant content—appears to be the key determinant of effective AI integration. Third, AI should be conceptualized not as a replacement for clinical teaching, but as a preparatory scaffold that enhances students' readiness for clinical participation. Although clinical readiness was not directly measured in this study, the proposed pathway suggests that AI-assisted pre-clerkship preparation may contribute to readiness through increased behavioral engagement, thereby addressing the pre-clinical cognitive scaffolding gap.

This study has several limitations. First, the single-institution design may limit generalizability. Second, the use of self-reported measures introduces potential response bias. Third, behavioral intention was measured using a single-item indicator, which may limit the depth of construct assessment. Finally, the study assessed anticipated engagement rather than actual usage or downstream learning outcomes. Future research should incorporate longitudinal and experimental designs to examine whether AI-assisted pre-clerkship preparation translates into improved clinical readiness and performance.

5. Conclusion

Medical students demonstrate favorable acceptance of AI-assisted pre-clerkship preparation, with perceived usefulness emerging as the primary driver of engagement. These findings support a model in which AI enhances pre-clerkship learning by increasing behavioral intention through perceived educational value. More broadly, this study suggests that AI-assisted pre-clerkship preparation may contribute to improved clinical readiness by addressing the pre-clinical cognitive scaffolding gap. Future research should move beyond acceptance to evaluate the impact of AI-supported preparation on learning outcomes and clinical performance.

Declarations

Ethics approval and consent to participate

This study (A Survey Study on the Acceptability of an "AI-Assisted Pre-study Mode" for Obstetrics and Gynecology Clerkships) was approved as exempt by the Hangzhou City University Review Board, Feb 06, 2026, HZCU2026-20.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

YPG designed the research, collected and analyzed data, and wrote the initial draft. JS collected data and made significant contributions to the manuscript writing. DYW designed the questionnaire, collected data, and guided the data analysis approach. WGL designed and reviewed the questionnaire, guided the data analysis approach, and provided important guidance for the manuscript writing. YMD designed and reviewed the questionnaire, guided the data analysis, and revised and improved the manuscript. LHZ reviewed the questionnaire, guided the paper writing, and revised and improved the manuscript. All authors read and approved the final manuscript.

Supplementary material

Supplementary material is available at *BMC Medical Education* online.

Previous presentations

This material has not been presented.

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Figures

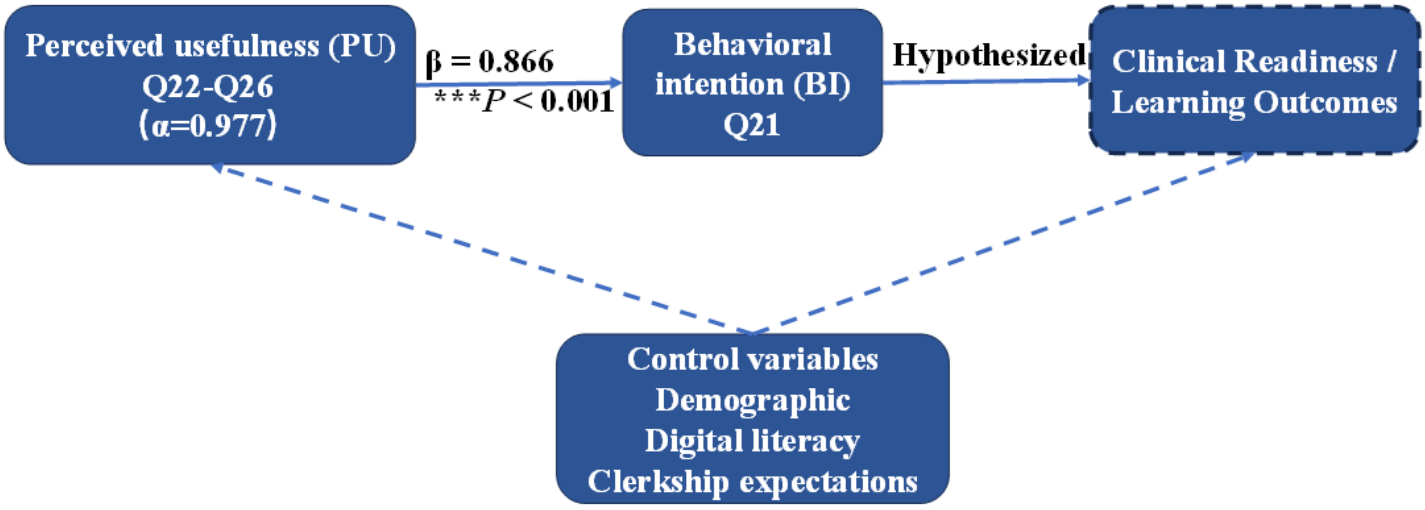


Figure 1

Extended Technology Acceptance Model of AI-assisted pre-clerkship preparation. Perceived usefulness (PU), measured by Q22–Q26 (Cronbach's α = 0.977), was the primary predictor of behavioral intention (BI), measured by Q21 (β = 0.866, ***$p < 0.001$). Behavioral intention was further hypothesized to influence clinical readiness and learning outcomes, reflecting the potential role of AI-assisted pre-clerkship preparation in addressing the pre-clinical cognitive scaffolding gap. Demographic characteristics, digital literacy, and clerkship expectations were included as control variables.

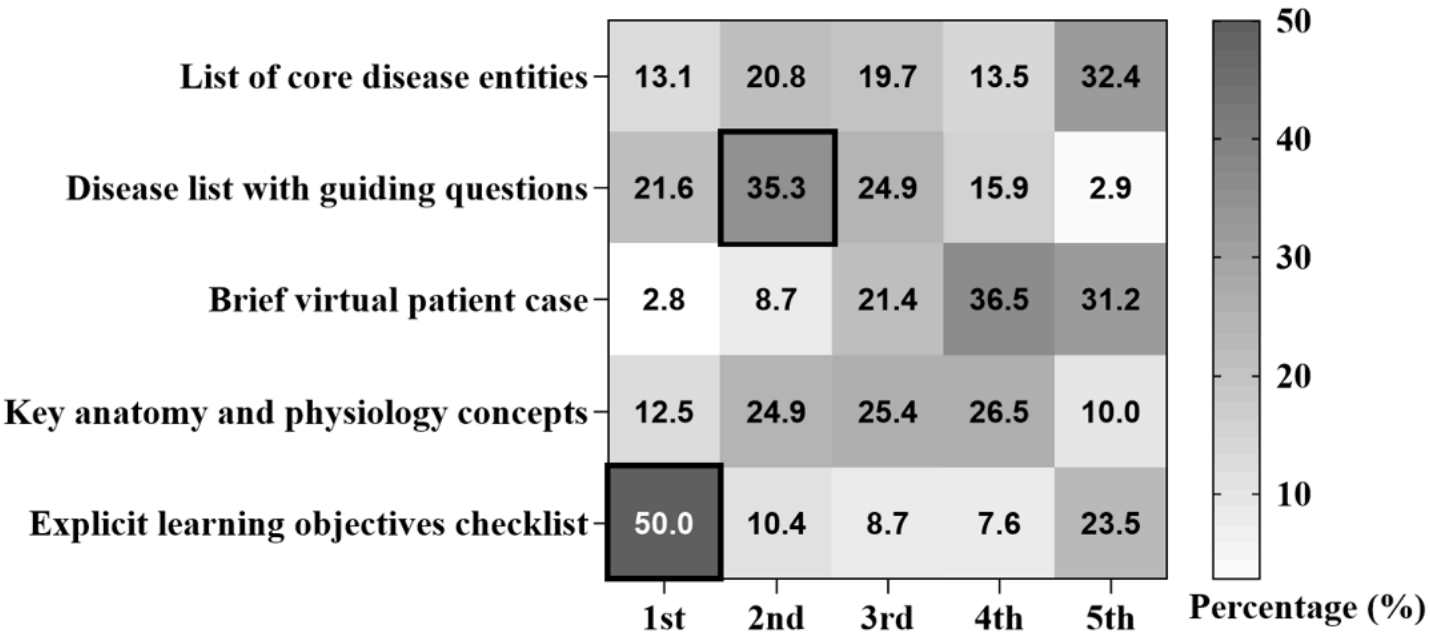


Figure 2

Students' prioritization of pre-clerkship learning materials. Values represent the percentage of students assigning each component to a given priority rank. Explicit learning objectives were most frequently ranked as the top priority, followed by disease lists with guiding questions. In contrast, virtual patient cases were more commonly ranked in lower priority positions.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplementarytable16.docx