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Original Article

Relationship Between Artificial Intelligence Usage and Awareness Among University Students in Microbiology Education: A Cross-Sectional Survey Study

Ansar Ali[1], Hamayun Khan[2], Hamas Fatima[3], Sayed Azan[1], Muhammad Kaif[1], Amna Sultan[1], Ayub Alam[4]

[1] Department of Microbiology, Abdul Wali Khan University, Mardan, Pakistan
[2] Institute of Nursing Sciences, Sarhad University of Science and Information Technology, Peshawar, Pakistan
[3] Department of Biological Sciences, BS Biotechnology, International Islamic University, Islamabad, Pakistan
[4] Iqra National University, Hayatabad, Peshawar, Pakistan

***Corresponding author: Hamayun Khan, hamayunkhn1@gmail.com; Muhammad Kaif, mkaif5140921@gmail.com**

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ABSTRACT

Background: Artificial intelligence tools are increasingly used in higher education, but evidence regarding their adoption and perceived understanding among students in microbiology and related disciplines remains limited. Objective: To describe AI-tool usage, self-reported AI knowledge, and academic characteristics among university students participating in a cross-sectional survey. Methods: A questionnaire-based cross-sectional survey was completed by 112 university students. A structured 25-item online questionnaire collected demographic, academic, AI-use, knowledge, and perception data. Categorical findings were summarised using frequencies and percentages. Percentages were calculated using the total sample or the valid item-specific denominator, as appropriate. Results: It was reported by 88 participants (78.6%), Gemini by 17 (15.2%), DeepSeek by 5 (4.5%), and other AI tools by 4 (3.6%). The 114 reported tool selections exceeded the sample size, indicating multiple responses or a source-data inconsistency. Among 107 respondents with valid knowledge data, 56 (52.3%) rated their AI knowledge as good, 35 (32.7%) as excellent, 15 (14.0%) as average, and 1 (0.9%) as poor. Five knowledge responses were unavailable. The sample included students from microbiology, computer science, biotechnology, and other departments and was predominantly undergraduate. No inferential analysis establishing an association between AI awareness and usage was available. Conclusion: AI-tool use and favourable self-rated AI knowledge were common among the surveyed students, although a statistical relationship between awareness and usage could not be established from the reported analysis. Keywords: Artificial Intelligence; AI Literacy; Microbiology Education; University Students; Higher Education; Cross-Sectional Survey.

INTRODUCTION

Artificial intelligence (AI) has become increasingly integrated into higher education, scientific communication, and research practice. AI-enabled systems support information retrieval, concept clarification, text generation, data organisation, and decision support, thereby influencing how university students engage with academic content and complete learning-related tasks (1–3). The widespread availability of generative AI platforms, particularly conversational large language models, has accelerated student exposure to AI and created new opportunities for personalised learning, rapid access to information, and interactive academic assistance (4,5).

The educational value of AI depends not only on access to these technologies but also on students' ability to use them critically and responsibly. AI literacy includes an understanding of basic AI concepts, recognition of system limitations, evaluation of generated information, protection of confidential data, and awareness of ethical and academic-integrity requirements. Although AI tools may improve the efficiency of selected academic activities, their outputs can contain factual inaccuracies, fabricated references, bias, and misleading interpretations. Excessive dependence on automated systems may also weaken independent reasoning when outputs are accepted without verification (4,7,8). Universities must therefore balance technological adoption with structured instruction in critical appraisal, transparency, accountability, and responsible use.

AI has particular relevance to microbiology and related biological sciences because these disciplines increasingly rely on computational analysis. Machine-learning approaches are used in genomics, microbial classification, disease surveillance, predictive modelling, and drug discovery, where large and complex datasets may exceed the capacity of conventional analytical methods (6,9). Students in microbiology, biotechnology, and allied disciplines may consequently encounter AI both as an educational resource and as an emerging component of scientific research. Familiarity with AI may help students understand contemporary analytical approaches, but self-perceived knowledge does not necessarily indicate the ability to evaluate AI-generated scientific information accurately.

Previous research has documented the expanding use of AI in higher education and has identified potential benefits for learning, teaching, and academic productivity (1–5). However, student engagement varies according to discipline, educational level, digital access, previous training, perceived usefulness, and institutional guidance. Concerns also persist regarding reliability, ethical use, academic misconduct, privacy, and dependence on automated content (7,8). Evidence describing AI use and self-reported understanding among students in microbiology-related education remains comparatively limited, particularly in multidisciplinary university samples from Pakistan.

Understanding which AI tools students use and how they evaluate their own knowledge can inform curriculum development and institutional policies. Such evidence may help universities identify the need for formal AI-literacy training, discipline-specific guidance, and safeguards for responsible academic use. The present study therefore aimed to describe AI-tool usage, self-reported AI knowledge, and academic characteristics among university students participating in a cross-sectional survey. The study also sought to characterise students' reported exposure to AI in microbiology and related educational contexts without assuming that self-reported knowledge represented objectively measured AI literacy.

MATERIALS AND METHODS

A questionnaire-based cross-sectional survey was conducted among university students to assess reported use of AI tools, self-perceived knowledge of AI, academic background, and perceptions regarding the application of AI in education and research. The survey included students from microbiology, computer science, biotechnology, and other academic departments and incorporated respondents from undergraduate and higher educational levels. Participation was voluntary, and students were informed of the purpose of the survey before submitting their responses.

Data were collected electronically using a structured 25-item questionnaire developed in Google Forms. The questionnaire included items addressing demographic characteristics, age, gender, academic department, educational level, familiarity with AI, AI platforms used, and participants' views regarding the educational and research applications of AI. The questionnaire was intended to capture both general exposure to AI technologies and students' self-reported understanding of their academic use. Knowledge of AI was recorded using the response categories poor, average, good, and excellent. AI-tool use was assessed using reported platform selections, including ChatGPT, Gemini, DeepSeek, and other AI applications.

The questionnaire was distributed electronically through student communication channels. Participants completed the survey independently on the basis of their existing knowledge, experience, and use of AI technologies. No intervention, training programme, or prescribed period of AI use was implemented before data collection. Responses were collected anonymously, and the survey did not request personally identifying information. Completion and submission of the questionnaire indicated voluntary consent to participate.

A total of 112 completed questionnaires were included in the analysis. Submitted responses were reviewed for completeness before analysis, and incomplete questionnaires were excluded from the primary dataset. Item-specific denominators were used when responses were unavailable for an individual variable. Five participants did not have a recorded response for the self-reported AI knowledge item, resulting in 107 valid responses for that analysis. For questions permitting more than one selection, response totals could exceed the number of participants; therefore, AI-tool selections were interpreted as non-mutually exclusive responses.

Google Forms responses were exported to Microsoft Excel for data cleaning, coding, and descriptive analysis. Categorical variables were summarised as frequencies and percentages. Percentages were calculated using the total sample of 112 participants when complete data were available and using the number of valid responses for variables with missing observations. For AI-tool use, percentages were calculated against the total participant sample, while the total number of tool selections was reported separately because multiple selections were recorded. Self-reported AI knowledge was summarised using 107 valid responses. Approximate departmental values and incomplete educational-level categories were not used to generate inferential estimates because their totals could not be fully reconciled with the overall sample.

The analysis was descriptive. No correlation coefficient, chi-square test, regression model, effect estimate, or p-value was calculated to establish a statistical association between AI awareness and AI usage. Consequently, the findings were interpreted as distributions of reported AI use and self-perceived knowledge rather than evidence of a statistically verified relationship. Results were presented using frequencies, percentages, tables, and a multipanel descriptive figure. Participant confidentiality was maintained throughout data collection and analysis. Participation was voluntary, respondents could decline to submit the questionnaire, and no identifying information was included in the analytical dataset. Survey responses were used exclusively for academic and research purposes and were analysed in aggregate form to prevent identification of individual participants.

RESULTS

A total of 112 university students participated in the survey. The available demographic data indicated that 78.4% of respondents were male and 21.6% were female. Most participants were aged 18–22 years (84.7%), followed by those aged 23–26 years (13.5%) and 26–32 years (1.8%). Exact frequencies for gender and age were not included in the present tables because the reported percentages did not correspond precisely to whole-number counts based on the total sample of 112.

Table 1. Reported Use of Artificial Intelligence Tools Among Participants

Artificial intelligence tool	Participants, n	Percentage of total sample, %	95% CI
ChatGPT	88	78.6	70.1–85.2
Gemini	17	15.2	9.7–23.0
DeepSeek	5	4.5	1.9–10.0
Other AI tools	4	3.6	1.4–8.8

CI: confidence interval. Percentages were recalculated using the total study sample of 112 participants. The reported selections totalled 114; therefore, the categories were treated as non-mutually exclusive responses. Confirmation from the original dataset is required before final publication.

ChatGPT was the most frequently reported AI tool, used by 88 of the 112 participants (78.6%; 95% CI: 70.1–85.2%). Gemini was reported by 17 participants (15.2%; 95% CI: 9.7–23.0%), whereas DeepSeek and other AI tools were reported by 5 (4.5%; 95% CI: 1.9–10.0%) and 4 participants (3.6%; 95% CI: 1.4–8.8%), respectively. The reported category counts totalled 114, indicating either that participants could select more than one platform or that the source data require reconciliation.

Table 2. Self-Reported Knowledge of Artificial Intelligence Among Participants With Valid Responses

Self-reported knowledge level	Participants, n	Valid percentage, %	95% CI
Excellent	35	32.7	24.6–42.1
Good	56	52.3	43.0–61.6
Average	15	14.0	8.7–21.8
Poor	1	0.9	0.2–5.1
Total valid responses	107	100.0	—

CI: confidence interval. Percentages were calculated using 107 valid responses. Five of the 112 participants did not have a reported response for this item.

Among the 107 participants with available knowledge-level data, 56 (52.3%; 95% CI: 43.0–61.6%) rated their knowledge of AI as good, and 35 (32.7%; 95% CI: 24.6–42.1%) rated it as excellent. Fifteen participants (14.0%; 95% CI: 8.7–21.8%) reported average knowledge, while one participant (0.9%; 95% CI: 0.2–5.1%) reported poor knowledge. Overall, 91 of the 107 respondents with valid data, representing 85.0%, rated their AI knowledge as either good or excellent.

Table 3. Academic Characteristics Reported in the Manuscript

Characteristic	Reported result
Participants from Microbiology	Approximately 54
Participants from Computer Science	Approximately 33
Participants from other departments	Approximately 22
Participants from Biotechnology	Exact number not stated
Undergraduate participants	89.3%
Postgraduate participants	5
Graduate participants	3
MPhil participants	1

The departmental and educational-level findings are reproduced separately because the manuscript did not provide complete, mutually exclusive counts that could be reconciled with the total sample of 112. These data should be replaced with exact frequencies and percentages from the source dataset before publication.

Microbiology was the most frequently represented academic department, followed by computer science and other disciplines. However, the reported departmental values were approximate, and the number of biotechnology participants was not specified. The sample was predominantly undergraduate, with 89.3% of respondents classified at this educational level. The additional categories of postgraduate, graduate, and MPhil participants did not account for the entire study sample and therefore could not be presented as a complete distribution. No inferential analysis examining the relationship between AI awareness and AI usage was available in the reported results. Consequently, no correlation coefficient, chi-square statistic, regression estimate, confidence interval for an association, or p-value could be reported. The available findings support a descriptive conclusion that AI-tool use—particularly ChatGPT use—and self-reported familiarity with AI were common among the surveyed participants. They do not independently establish the strength, statistical significance, or direction of a relationship between awareness and usage.

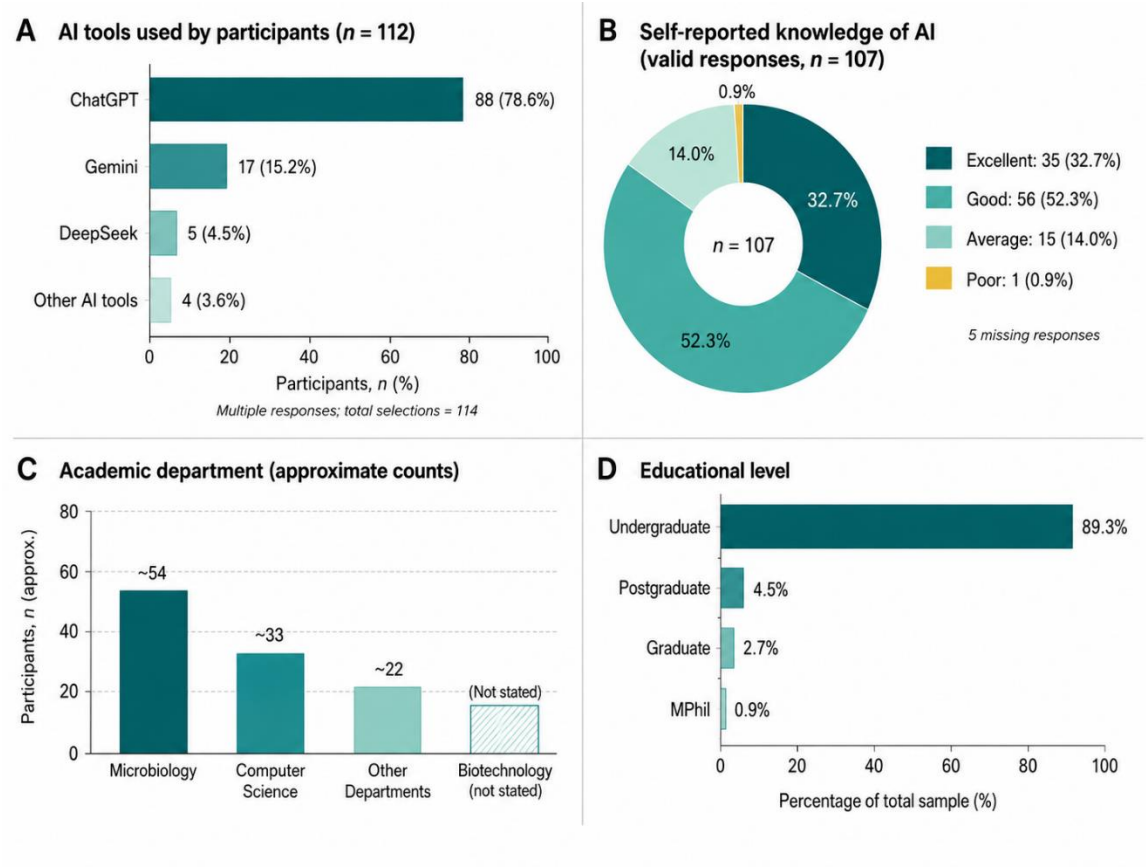

Figure 1 presents a four-panel descriptive summary of AI use and participant characteristics. Panel A shows that ChatGPT was the most frequently reported tool, used by 88 participants (78.6%), followed by Gemini in 17 (15.2%), DeepSeek in 5 (4.5%), and other AI tools in 4 (3.6%); the 114 total selections indicate that multiple responses were recorded. Panel B shows that, among 107 valid responses, 56 participants (52.3%) rated their AI knowledge as good, 35 (32.7%) as excellent, 15 (14.0%) as average, and 1 (0.9%) as poor, with five missing responses. Panel C indicates that approximately 54 participants were from microbiology, 33 from computer science, and 22 from other departments, while the exact biotechnology count was not stated. Panel D shows that undergraduate students constituted 89.3% of the sample, whereas postgraduate, graduate, and MPhil participants represented 4.5%, 2.7%, and 0.9%, respectively.

DISCUSSION

The present cross-sectional survey showed that AI tools were widely used among the participating university students, with ChatGPT reported substantially more often than Gemini, DeepSeek, or other platforms. Among respondents with valid knowledge-level data, most rated their understanding of AI as good or excellent. These findings indicate extensive exposure to AI-assisted technologies and generally favourable self-perceived familiarity with AI among the surveyed students. However, because the available analysis was descriptive, the findings do not establish the strength or statistical significance of a relationship between AI awareness and usage.

The predominance of ChatGPT was consistent with the rapid adoption of generative AI tools in higher education. Large language models can support information retrieval, concept clarification, drafting, summarisation, and interactive learning, which may explain their appeal to university students (1–4). Their conversational interface and broad accessibility may also make them easier to adopt than specialised AI platforms. Nevertheless, the present study measured reported tool use rather than objectively verified frequency, duration, academic purpose, or quality of use. The results should therefore be interpreted as a description of participants' reported exposure to selected AI tools rather than evidence of effective or academically appropriate use.

Most respondents with valid knowledge data classified their AI knowledge as good or excellent. This pattern may reflect increasing contact with AI-supported educational applications and the growing visibility of generative AI in academic environments. Previous literature has similarly identified

expanding student engagement with AI-assisted learning and has highlighted the potential of these systems to facilitate personalised support, rapid access to information, and interaction with complex educational content (1–5). However, the knowledge measure used in the present survey was self-reported. It may therefore represent perceived familiarity rather than objectively assessed AI literacy, which would also include the ability to evaluate outputs, recognise algorithmic limitations, verify information, protect confidential data, and apply AI tools ethically.

The inclusion of students from microbiology, computer science, biotechnology, and other departments demonstrated that interest in AI extended beyond a single academic discipline. This multidisciplinary composition was relevant because AI is increasingly applied across biological and computational sciences. In microbiology and related biomedical fields, machine-learning approaches have contributed to genomic analysis, microbial classification, disease prediction, drug discovery, and interpretation of complex biological datasets (6,9). Students' exposure to these developments may increase their interest in AI-assisted academic and research activities. At the same time, the substantial representation of computer-science students may have increased the overall reported level of familiarity with AI. Departmental background should therefore be considered as a potential confounding factor in future analyses.

Although AI tools can improve the efficiency of selected academic tasks, their use also introduces concerns related to inaccurate information, fabricated citations, algorithmic bias, academic integrity, privacy, and excessive dependence on automated output. Ethical frameworks for AI emphasise human oversight, transparency, accountability, fairness, and the preservation of independent judgement (7,8). In microbiology education, these principles are particularly important because inaccurate interpretation of scientific evidence may affect laboratory reasoning, research reporting, and subsequent professional decision-making. AI-generated material should therefore be critically evaluated against reliable scientific sources rather than accepted without verification.

The findings support the inclusion of structured AI literacy within university curricula. Such education should extend beyond basic familiarity with individual platforms and should address prompt formulation, output verification, reference checking, data confidentiality, academic attribution, bias recognition, and discipline-specific applications. In microbiology-related programmes, AI instruction could be integrated with bioinformatics, scientific writing, research methods, and evidence appraisal. This approach may help students use AI as a supervised educational aid while maintaining scientific reasoning and academic accountability.

The study had several strengths. It addressed a timely educational issue, included students from multiple academic backgrounds, and assessed several dimensions of AI exposure and self-perceived knowledge. Nevertheless, important limitations restricted interpretation. The relatively small sample, predominance of undergraduate respondents, voluntary online recruitment, and unclear sampling frame may have introduced selection bias and limited generalisability. Participants already interested in AI may have been more likely to complete the survey. The questionnaire's validity, reliability, scoring method, and pilot-testing procedures were not documented, while the data were self-reported and susceptible to recall and social-desirability bias. Several variables also contained incomplete or internally inconsistent totals. In particular, five participants had no reported knowledge-level response, the AI-tool selections exceeded the number of participants, and the departmental and educational-level distributions could not be fully reconciled with the total sample.

The cross-sectional design prevented determination of temporal or causal relationships. It could not establish whether greater awareness encouraged AI use, whether repeated use increased perceived knowledge, or whether both were influenced by academic discipline, educational level, age, digital access, or previous training. Furthermore, the manuscript did not provide an inferential analysis of the relationship stated in the article title. Future studies should use validated AI-literacy and usage instruments, recruit larger multisite samples, report item-specific missing data, and apply appropriate

association and multivariable analyses. Longitudinal or interventional studies would be valuable for determining whether structured AI-literacy education improves critical appraisal, ethical practice, academic performance, or research competency.

CONCLUSION

AI-tool use, particularly the use of ChatGPT, was common among the surveyed university students, and most respondents with valid data rated their knowledge of AI as good or excellent. These descriptive findings indicate substantial exposure to AI technologies across microbiology and other academic disciplines but do not establish a statistically verified relationship between AI awareness and usage. Universities should support responsible AI engagement through structured instruction in critical evaluation, ethical use, academic integrity, data protection, and discipline-specific application while preserving independent scientific judgement.

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