

Article

Artificial Intelligence Adoption and the Need for Artificial Intelligence Literacy in Veterinary Education: A Cross-Sectional Survey

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Abstract

Artificial intelligence (AI) is rapidly transforming veterinary education and practice, increasing the need for AI literacy among future veterinary professionals. However, evidence regarding veterinary students' knowledge, use, and perceptions of AI remains limited. This cross-sectional study evaluated AI awareness, usage patterns, attitudes, and educational expectations among undergraduate veterinary students at the University of Las Palmas de Gran Canaria (Spain). A semi-structured online questionnaire was completed by 189 students (43% of the target population), and data were analysed using descriptive statistics and tests of association, with Monte Carlo procedures when appropriate and false discovery rate adjustment for multiple comparisons. Most students reported frequent use of generative AI tools, particularly ChatGPT, mainly for information retrieval and academic support. Participants generally perceived AI as a valuable educational resource but expressed concerns regarding the reliability of AI-generated information, ethical issues, data privacy, and the potential impact on critical thinking. Despite widespread AI use, most respondents reported limited formal training and insufficient institutional guidance, while strongly supporting the integration of AI-related competencies into the veterinary curriculum. These findings highlight a gap between the rapid adoption of AI and the development of formal AI literacy in veterinary education. Veterinary curricula should promote not only technical proficiency but also critical evaluation, ethical awareness, and the responsible use of AI in professional practice.

Keywords: artificial intelligence; generative artificial intelligence; artificial intelligence literacy; cross-sectional survey; higher education; veterinary education



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1. Introduction

Artificial intelligence (AI), particularly generative AI based on large language models, has rapidly changed higher education by transforming how students obtain information,

create content, solve problems, and engage with learning activities. AI-powered tools, including ChatGPT, Gemini, and Copilot, provide relevant opportunities for personalized learning, academic writing support, rapid information retrieval, and reinforced accessibility to learning opportunities. Simultaneously, their widespread adoption poses important challenges related to academic integrity, assessment methods, digital literacy, and the responsible and ethical use of AI in higher education [1–3].

Beyond education, AI is becoming increasingly integrated into human and veterinary medicine. Consequently, AI applications support diagnostic imaging, clinical decision-making, disease surveillance, precision medicine, epidemiological analysis, and biomedical research [4]. As these technologies become progressively incorporated into veterinary practice, future veterinarians will require not only technical familiarity with AI tools but also the ability to critically evaluate AI-generated information, recognize its limitations, and understand its ethical, legal, and professional implications [4–7]. Therefore, AI literacy has emerged as an essential competency for healthcare professionals. It extends beyond the ability to use AI applications and includes understanding fundamental AI concepts, critically evaluating AI-generated outputs, recognizing potential biases and limitations, addressing ethical and privacy issues, and integrating AI responsibly into professional decision-making. Accordingly, universities are increasingly encouraged to incorporate AI-related competencies into their curricula to prepare graduates for technology-driven professional environments [5,8,9].

Recent studies involving medical, dental, nursing, and allied health consistently describe positive attitudes towards AI and strong interest in formal AI education [1–3,9]. Nonetheless, these investigations also report significant differences in AI-related knowledge, practical competencies, and curricular exposure. Students generally identify the potential benefits of AI while expressing important concerns regarding reliability, academic integrity, algorithmic bias, data privacy, transparency, and possible effects on critical thinking and professional judgment [2,7].

Within veterinary education, available evidence suggests that students are increasingly familiar with AI tools and generally recognize their potential educational and professional applications, including support for diagnosis, clinical decision-making, veterinary management, and animal monitoring [4,7]. However, the available evidence also points to important limitations, particularly regarding formal AI training, reliability of AI-generated information, ethical use, transparency, and the potential effects of AI on critical thinking and professional judgment [7]. Importantly, existing veterinary studies have generally examined selected aspects of AI awareness, attitudes, or intended applications, while evidence integrating students' knowledge, actual usage patterns, perceived educational impact, ethical practices, institutional guidance, and future expectations remains limited. Moreover, most available evidence derives from individual institutional settings, making it difficult to determine whether reported patterns are consistent across different veterinary educational contexts [7]. These gaps highlight the need for institution-specific studies that provide a broader characterization of how veterinary students engage with AI and how they perceive its educational and professional implications.

Accordingly, a better understanding of veterinary students' knowledge, use, and perceptions of AI is needed to inform the design of evidence-based educational strategies that promote responsible AI use, strengthen digital competencies, and facilitate the effective integration of AI into veterinary curricula and future professional practice. To address these gaps, the present study aimed to answer the following research questions (RQ):

RQ1. What are veterinary students' levels of knowledge, awareness, and usage of AI technologies?

RQ2. How do veterinary students perceive the educational impact, benefits, risks, and ethical implications of AI use?

RQ3. What are students' views regarding institutional guidance, AI literacy training, and the future integration of AI into veterinary education and professional practice?

RQ4. Do AI-related knowledge, usage patterns, perceptions, and attitudes differ according to students' academic stage and gender?

To answer these questions, we conducted a cross-sectional survey among undergraduate veterinary students at the University of Las Palmas de Gran Canaria. The findings are expected to contribute to the emerging evidence on AI in veterinary education and to support the development of curricula, institutional policies, and training initiatives that foster the responsible and effective use of AI by future veterinary professionals. The remainder of this paper is organized as follows. Section 2 describes the related work, Section 3 shows the materials and methods, Section 4 presents the results, Section 5 discusses the findings, and Section 6 provides the main conclusions.

2. Related Work

AI has increasingly been investigated in health professions education, where studies have generally reported positive attitudes toward its educational potential alongside concerns regarding accuracy, bias, academic integrity, privacy, and overreliance. Research involving medical, dental, nursing, pharmacy, and other healthcare students suggests that AI is already being used for information retrieval, clarification of concepts, learning support, and academic tasks, although students' knowledge and practical competence vary considerably. Importantly, frequent use of AI does not necessarily imply adequate AI literacy, as students may have limited understanding of how AI systems work, their limitations, or the ethical and professional implications of their use [5,8,9].

Within veterinary education, the literature remains comparatively limited but indicates increasing familiarity with AI and growing interest in its educational and professional applications. Previous studies have examined veterinary students' awareness, attitudes, and intended or reported uses of AI, including the use of generative AI for academic tasks and learning support [4,6,7]. These studies have generally identified positive perceptions of AI, while also highlighting concerns regarding reliability, misinformation, academic integrity, and the potential effects of AI on critical thinking. At the same time, formal curricular preparation has remained limited, suggesting that veterinary students may acquire much of their AI knowledge through informal or self-directed learning.

Recent evidence from Oropesa et al. [10], based on 340 veterinary students from Spain and Portugal, further highlights this gap. Although students generally expressed positive attitudes toward AI, formal training was limited and self-directed learning was the most common source of AI knowledge. Students with previous AI training reported higher self-perceived knowledge and AI use, as well as more positive attitudes toward educational applications of AI [10]. These findings support the need for structured educational approaches that address AI literacy rather than focusing solely on the technical use of individual AI tools.

Evidence from veterinary professionals also suggests that high AI adoption may co-exist with limited familiarity. Li and Lai [11], in a cross-sectional study of 455 veterinary professionals in China, reported that 71.0% of participants used AI, while 44.6% of active users reported low familiarity with AI. Reliability and accuracy were identified as major barriers to adoption, and respondents expressed strong support for regulatory oversight and additional training. The authors emphasized the importance of developing AI literacy, critical appraisal skills, and appropriate regulatory frameworks to support responsible clinical

cal use [11]. Together, these findings indicate that AI adoption is occurring across veterinary education and practice faster than formal educational structures are being established.

Despite this growing body of evidence, previous studies have often focused on specific dimensions of AI adoption, such as awareness, attitudes, intended applications, or training needs. Less attention has been given to the relationship between students' self-perceived knowledge, actual patterns of AI use, perceived educational impact, ethical practices, institutional guidance, and expectations regarding future professional use within a single study. The present study addresses this gap by providing an integrated assessment of these dimensions among undergraduate veterinary students at the University of Las Palmas de Gran Canaria (ULPGC).

3. Materials and Methods

3.1. Study Design and Ethical Considerations

This cross-sectional study was conducted among veterinary students at the Faculty of Veterinary Medicine of the University of Las Palmas de Gran Canaria (Spain). Data collection took place between February and March 2026. Participation was voluntary and anonymous, and no personal identifying information was collected, thereby ensuring participant confidentiality. All data were collected and processed exclusively for research purposes. The reporting of this observational study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [12].

According to the institutional guidance provided by the Ethics Committee of the University of Las Palmas de Gran Canaria, formal ethical approval was not required for this study because it involved an anonymous, voluntary questionnaire that did not collect identifiable personal data or involve any intervention with participants. Consequently, written informed consent was not required.

3.2. Participants

This investigation evaluated the perceptions of students enrolled in the degree of Veterinary Medicine at the University of Las Palmas de Gran Canaria (ULPGC) during the 2025–2026 academic year. The target population comprised approximately 440 undergraduate veterinary students. A convenience sampling strategy was used. The survey was disseminated through regular teaching activities across the Veterinary Medicine programme, during which students received a brief oral explanation of the study objectives and procedures and were provided with a Quick Response (QR) code to access the online questionnaire. A total of 189 students completed the questionnaire, corresponding to approximately 43% of the target population. Because participation was voluntary and recruitment relied on students being reached through regular teaching activities, equal exposure to the survey invitation among all eligible students could not be guaranteed.

3.3. Inclusion and Exclusion Criteria

Eligible participants were students aged 18 years or older who were actively enrolled in the degree of Veterinary Medicine at the ULPGC and completed the survey during the data collection period. Participants who accessed the survey but did not answer any multiple-choice questions were excluded from the analysis. For analysis of individual questionnaire items, participants with missing responses for a given item were excluded only from the corresponding analyses.

3.4. Survey Instrument

A semi-structured online questionnaire was specifically developed de novo for this study to assess veterinary students' self-reported knowledge, awareness, use, perceptions,

and attitudes regarding AI in higher education. The questionnaire was not intended to provide an objective or validated measure of AI literacy. Accordingly, the term AI literacy, when used in this study, refers to students' perceived knowledge and awareness of AI and their self-reported ability to engage with AI tools, rather than to objectively measured AI literacy competencies. Moreover, it was developed following a review of recent literature on AI use in higher education, digital competence, and applications of AI in medical and veterinary education [1,2,7,9,13–16]. The literature was used to identify the main domains relevant to the study objectives and to guide the formulation of the individual items. The resulting questionnaire was reviewed by the research team to assess whether the items adequately covered the relevant aspects of AI use and its educational implications in veterinary education. The questionnaire was therefore developed specifically for the present study rather than adapted from a previously validated instrument.

The questionnaire comprised 29 items organized into eight sections: (1) demographic and academic information, (2) knowledge and awareness of AI, (3) AI usage patterns, (4) perceptions and attitudes, (5) impact on learning, (6) institutional and ethical context, (7) future expectations, and (8) additional comments. Items were formulated to address the specific domains identified in the literature and the objectives of the study. The questionnaire was administered in Spanish using Google Forms and required approximately 10–15 min to complete. It consisted primarily of closed-ended questions with single- or multiple-response options, depending on the construct being assessed. Most items used categorical response scales, while selected questions allowed multiple responses to capture the diversity of AI tools and their educational applications. An optional open-ended question at the end of the survey enabled participants to provide additional comments or suggestions regarding the use of AI in veterinary education.

3.5. Data Management and Analysis

Questionnaire responses were exported from the online survey platform into Microsoft Excel for data coding and preliminary quality control. The dataset was reviewed to identify inconsistencies, verify completeness, and detect duplicate records before statistical analysis. Missing data were handled using pairwise deletion, whereby participants with missing responses for a specific questionnaire item were excluded only from the corresponding analysis. Percentages were calculated using the number of valid responses for each item as the denominator.

Statistical analyses were performed using IBM SPSS Statistics version 30.0. Descriptive statistics were used to summarize participant characteristics and questionnaire responses. Categorical variables were expressed as frequencies and percentages. For multiple-response questions, each response option was analysed independently, and percentages were calculated using the number of respondents who answered the corresponding question as the denominator. For the statistical analysis, academic year was dichotomized into academic stage to provide a more balanced comparison between students at different stages of the Veterinary Medicine programme and to reduce sparse cell counts resulting from the uneven distribution of participants across individual academic years. Students enrolled in the first and second academic years were classified as early-stage students, whereas those enrolled in the third, fourth, and fifth academic years were classified as advanced-stage students, as previously described [9]. Associations between categorical variables were assessed using Pearson's chi-square test of independence, as appropriate. Cramér's V was calculated as a measure of the strength of association. When the assumptions of the chi-square test were not adequately met because of low expected cell frequencies, statistical significance was assessed using an exact conditional Monte Carlo procedure. To account for multiple

comparisons, the Benjamini–Hochberg procedure was applied to control the false discovery rate (FDR). Statistical significance was set at p -value < 0.05 .

4. Results

4.1. Descriptive Characteristics of Veterinary Students

A total of 189 veterinary students completed the survey. Significant differences were observed in the distribution of age groups, gender, and academic year (Chi-square test, $p < 0.001$ for all comparisons). Students aged 20 to 22 years represented the largest age group (48.2%), followed by those aged 17 to 19 years (25.4%), while participants older than 28 years accounted for only 2.6%. Female students predominated in the sample, representing 78.8% of respondents, compared with 21.2% males. Regarding academic year, first-year (28.6%) and fourth-year (27.5%) students were the most represented groups, whereas third-year students constituted only 6.3% of the sample (Table 1). The distribution of participants across academic years was therefore uneven, with particularly low representation of third-year students (6.3%, $n = 12$).

Table 1. Demographic and academic information of undergraduate veterinary students.

Variable	n	%	χ^2	gl	p -Value
Age groups [years] [N = 189]					
17–19 years	48	25.4%	126.7	4	<0.001
20–22 years	91	48.1%			
23–25 years	35	18.5%			
26–28 years	10	5.3%			
>28 years	5	2.6%			
Gender [N = 189]					
Man	40	21.2%	62.9	1	<0.001
Woman	149	78.8%			
I prefer not to specify	0	0%			
Year of study [N = 189]					
1st year	54	28.6%	34.0	4	<0.001
2nd year	44	23.3%			
3rd year	12	6.3%			
4th year	52	27.5%			
5th year	27	14.3%			

A statistically significant association was observed between age category and academic year (Pearson's $\chi^2 = 78.765$, $df = 16$). Because several cells had expected frequencies below 5, statistical significance was assessed using an exact conditional Monte Carlo procedure with 1,000,000 simulated tables. The association remained statistically significant (Monte Carlo $p < 0.001$). Similarly, age was also strongly associated with academic stage ($\chi^2 = 64.56$, $df = 4$, Monte Carlo $p < 0.001$, Cramér's $V = 0.567$). In contrast, no statistically significant association was observed between gender and academic stage ($\chi^2 = 3.51$, $df = 1$, $p = 0.061$) or between age and gender (Monte Carlo $p = 0.835$).

4.2. Knowledge and Awareness About AI

Most students reported a moderate level of familiarity with AI, with 83.6% indicating that they understood its basic principles and 11.1% stating that they had advanced knowledge and could explain technical concepts. ChatGPT was recognized by all participants as an AI tool, followed by GitHub Copilot, Google Translate, and Grammarly. However, formal education on AI was limited, as 59.8% of students reported not having received any specific training, although about one quarter indicated that their university

had provided general information about AI. Only a small proportion had received basic instruction during classes or attended dedicated workshops (Figure 1). No statistically significant associations were observed between academic stage and self-reported familiarity with AI (Monte Carlo $p = 0.907$), previous AI-related training (Monte Carlo $p = 0.513$), or the identification of the individual tools included in the questionnaire as AI-based tools (all $p > 0.05$).

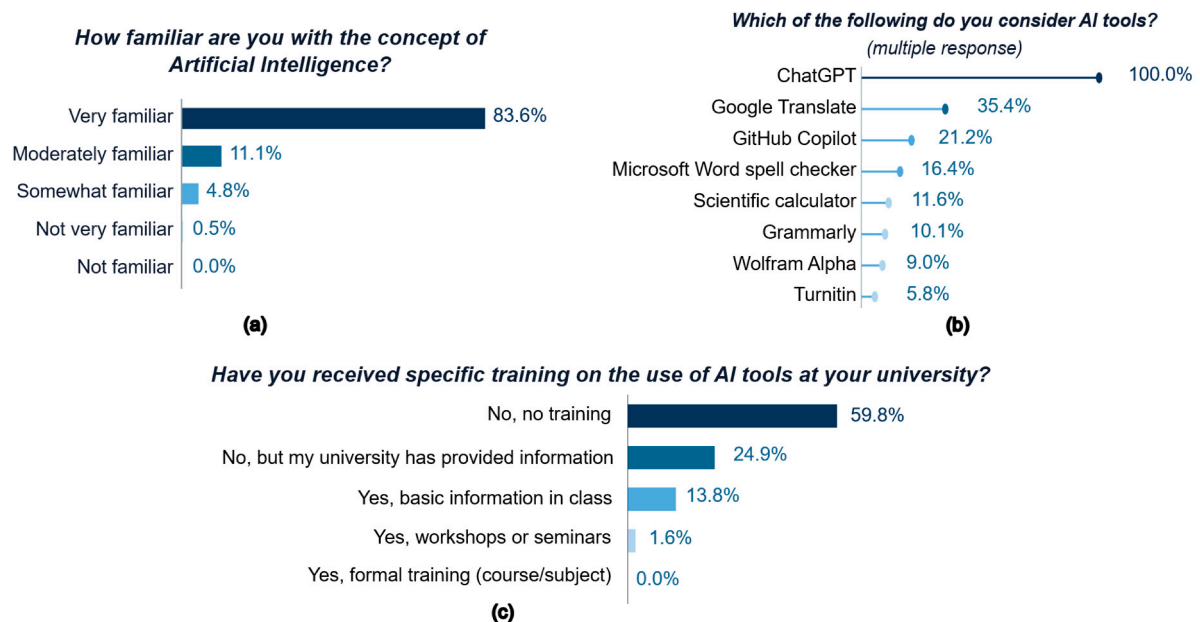


Figure 1. Veterinary students' familiarity with AI, recognition of AI tools, and previous university AI training: (a) self-reported familiarity; (b) identification of AI tools; and (c) previous AI training. Data are expressed as percentages.

4.3. AI Usage Patterns

Most students reported using AI tools either regularly or occasionally (87.3%, $n = 165$) for their studies, with frequent use throughout the week, including several times per week or daily (71.5%, $n = 133$). ChatGPT was by far the most widely used tool (87.1%, $n = 162$), followed by Google Gemini (52.2%, $n = 97$). AI was primarily used to answer specific questions and resolve doubts (94.1%, $n = 175$), search and analyze information (61.3%, $n = 114$), prepare for exams (60.2%, $n = 112$), and generate ideas (50.5%, $n = 94$). It was also frequently used for individual assignments (87.1%, $n = 162$) and group projects (75.3%, $n = 140$), whereas its use in permitted online examinations was less common (19.9%, $n = 37$). Most students began using AI during their first year at university (38.7%, $n = 72$) or before entering higher education (32.8%, $n = 61$). Among the three students who had never used AI tools, two reported a lack of knowledge about how to use them and one reported concern regarding academic integrity (Figure 2). Given the very small number of non-users, these observations should be interpreted descriptively and do not permit meaningful subgroup comparisons.

Statistically significant associations were observed between academic stage and overall AI use ($\chi^2 = 11.915$, Monte Carlo $p = 0.013$, FDR-adjusted $p = 0.013$, Cramér's $V = 0.252$), frequency of AI use ($\chi^2 = 20.549$, Monte Carlo $p < 0.001$, FDR-adjusted $p < 0.001$, Cramér's $V = 0.332$), and timing of first AI use ($\chi^2 = 67.798$, Monte Carlo $p < 0.001$, FDR-adjusted $p < 0.001$, Cramér's $V = 0.604$). Regular AI use was reported by 57.7% of early-stage students compared with 39.6% of advanced-stage students. Similarly, daily AI use was more frequent among early-stage students (32.7%) than among advanced-stage students (14.8%). The largest difference between academic stages was observed for the timing of

first AI use. More than half of early-stage students (57.1%) reported having started using AI before entering university, compared with 5.7% of advanced-stage students.

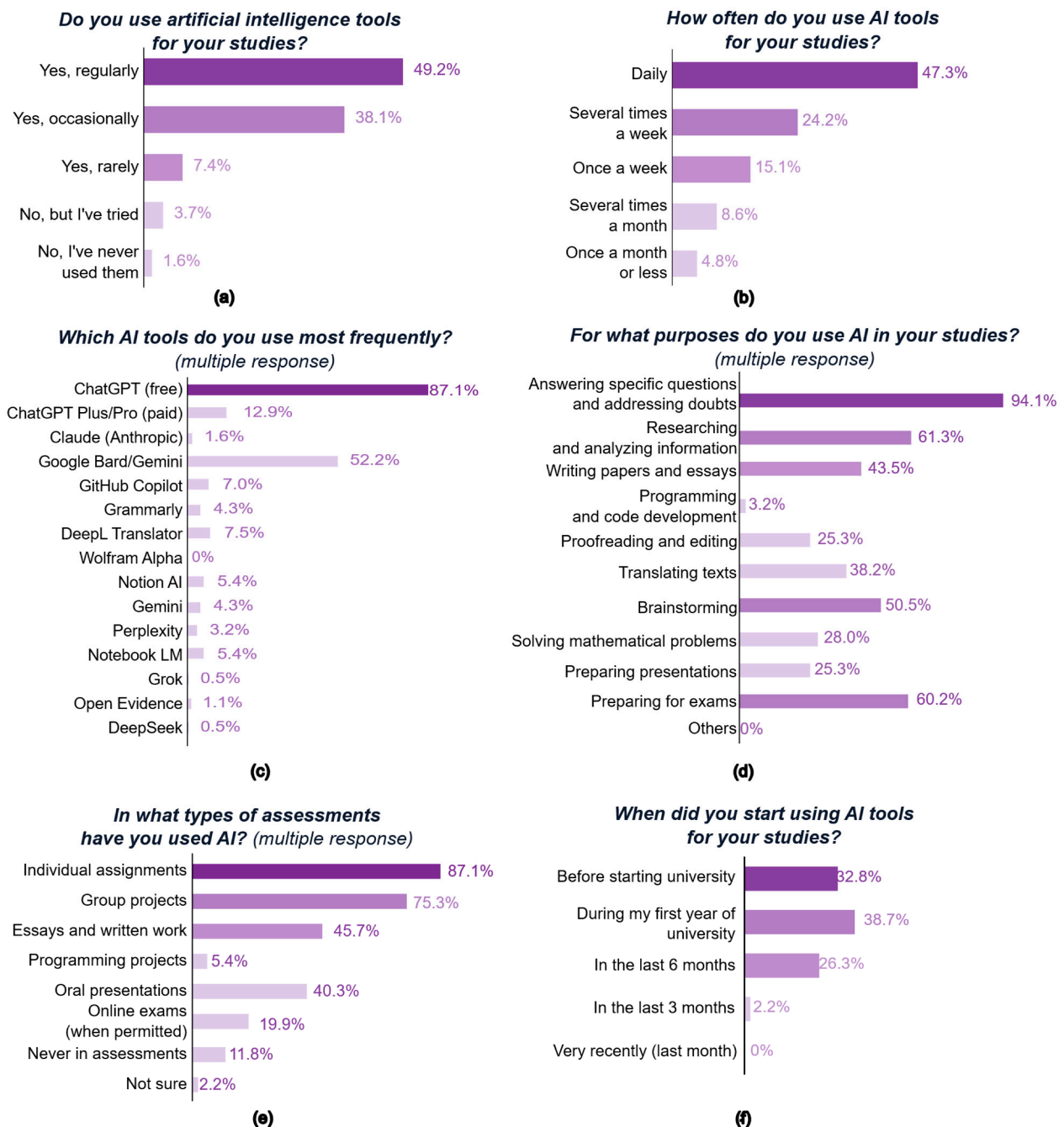


Figure 2. Patterns of AI use among veterinary students: (a) academic use; (b) frequency of use; (c) most frequently used tools; (d) purposes of use; (e) use in assessments; and (f) onset of AI use.

Analysis of individual options from multiple-response questions identified several additional differences according to academic stage after correction for multiple comparisons. Google Bard/Gemini was reported more frequently by early-stage than advanced-stage students (74.5% vs. 37.5%, FDR-adjusted $p < 0.001$). Early-stage students also more frequently reported using AI for examination preparation (72.4% vs. 46.6%, FDR-adjusted $p = 0.004$), solving mathematical problems (46.9% vs. 6.8%, FDR-adjusted $p < 0.001$), and resolving specific questions or doubts (100.0% vs. 87.5%, FDR-adjusted $p = 0.002$).

4.4. Perceptions and Attitudes

Students generally had a positive perception of AI, with 90.5% either strongly agreeing or agreeing (90.5%, $n = 171$) that AI can improve learning. The most frequently reported benefits were significant time savings (91.4%, $n = 170$), improved understanding of complex concepts (79.0%, $n = 147$), and personalized learning support (62.9%, $n = 117$). More than half of the respondents also stated that AI improved the quality of their academic work (52.2%, $n = 97$). However, students expressed several concerns, particularly the risk of receiving inaccurate information (90.4%, $n = 170$), being accused of academic dishonesty (58.0%, $n = 109$), becoming dependent on AI tools (56.9%, $n = 107$), and reduced critical thinking skills (55.3%, $n = 104$). Regarding the potential impact on learning abilities, 40.2% ($n = 76$) were somewhat concerned that AI could negatively affect their learning, while 31.7% ($n = 60$) remained neutral (Figure 3).

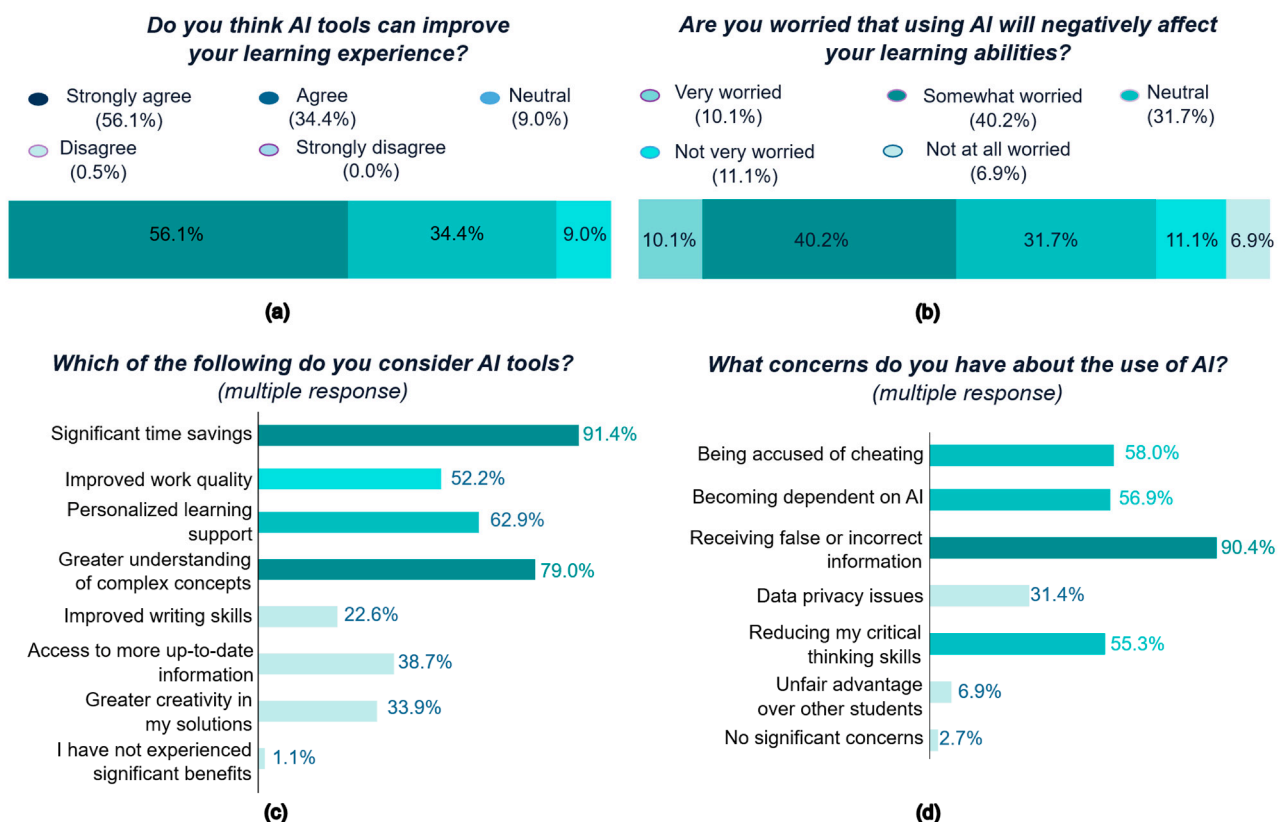


Figure 3. Veterinary students' perceptions, benefits, and concerns regarding AI use in education: (a) perceived impact on learning; (b) concern about potential negative effects on learning; (c) reported benefits; and (d) main concerns. Data are expressed as percentages.

Several AI-related variables showed statistically significant associations with academic stage in the initial analyses. However, after adjustment for multiple comparisons using the Benjamini–Hochberg procedure, only the association between academic stage and reporting greater understanding of complex concepts as a benefit of AI use remained statistically significant. Early-stage students reported this benefit more frequently than advanced-stage students (86.7% vs. 68.1%, respectively), with a statistically significant association after FDR adjustment ($\chi^2 = 9.448$, FDR-adjusted $p = 0.036$, Cramér's $V = 0.224$). No other associations between academic stage and the AI-related variables remained statistically significant after adjustment for multiple comparisons.

4.5. Impact on Learning

Most students perceived a positive impact of AI on their learning, with 83.6% ($n = 158$) reporting that AI had somewhat improved their understanding of course content or indicating a significant improvement. AI was also associated with changes in study habits, with 75.5% ($n = 142$) of respondents reporting at least minor changes in their study methods, of whom 11.2% ($n = 21$) stated that AI had completely transformed the way they study. Regarding skill development, 47.4% ($n = 89$) reported acquiring some or many new skills through AI use, although 34.0% ($n = 64$) were uncertain about its contribution (Figure 4).

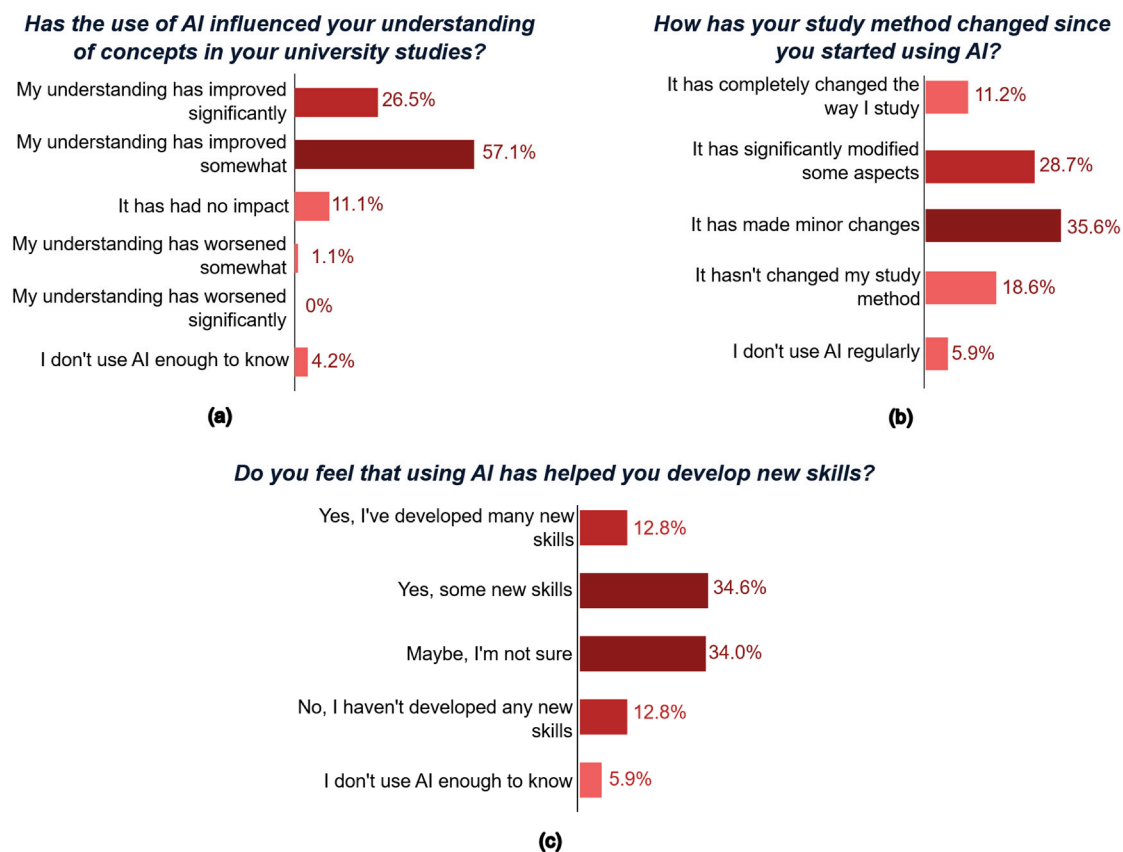


Figure 4. Perceived impact of AI on learning among veterinary students: (a) understanding of course content; (b) changes in study methods; and (c) development of new skills. Data are expressed as percentages; sample sizes vary slightly because of missing responses.

Associations between academic stage and the perceived impact of AI were examined across the three variables included in this domain. After adjustment for multiple comparisons using the Benjamini–Hochberg procedure, only the association between academic stage and changes in study methods since using AI remained statistically significant ($\chi^2 = 16.750$, $df = 4$, FDR-adjusted $p = 0.007$, Cramér's $V = 0.298$). Advanced-stage students more frequently reported that AI had not changed their study methods than early-stage students (27.5% vs. 10.3%, respectively). No statistically significant associations after FDR correction were observed between academic stage and the perceived influence of AI on the understanding of university concepts or the perceived development of new skills through AI use.

4.6. Institutional and Ethical Context

Students reported considerable uncertainty regarding institutional policies on AI use, with 37.6% ($n = 71$) perceiving that their university had no clearly defined policy and 37.0% ($n = 70$) believing that AI was permitted under certain restrictions. Guidance on the

appropriate use of AI was generally limited, as 80.7% ($n = 151$) reported receiving little guidance, unclear guidance or no guidance at all. Most students (74.5%, $n = 140$) considered that whether AI use constitutes academic cheating depends on how the technology is used. In addition, transparency regarding AI use in academic assignments was relatively low, with 57.9% ($n = 109$) reporting that they never disclose its use or do so only rarely (Figure 5).

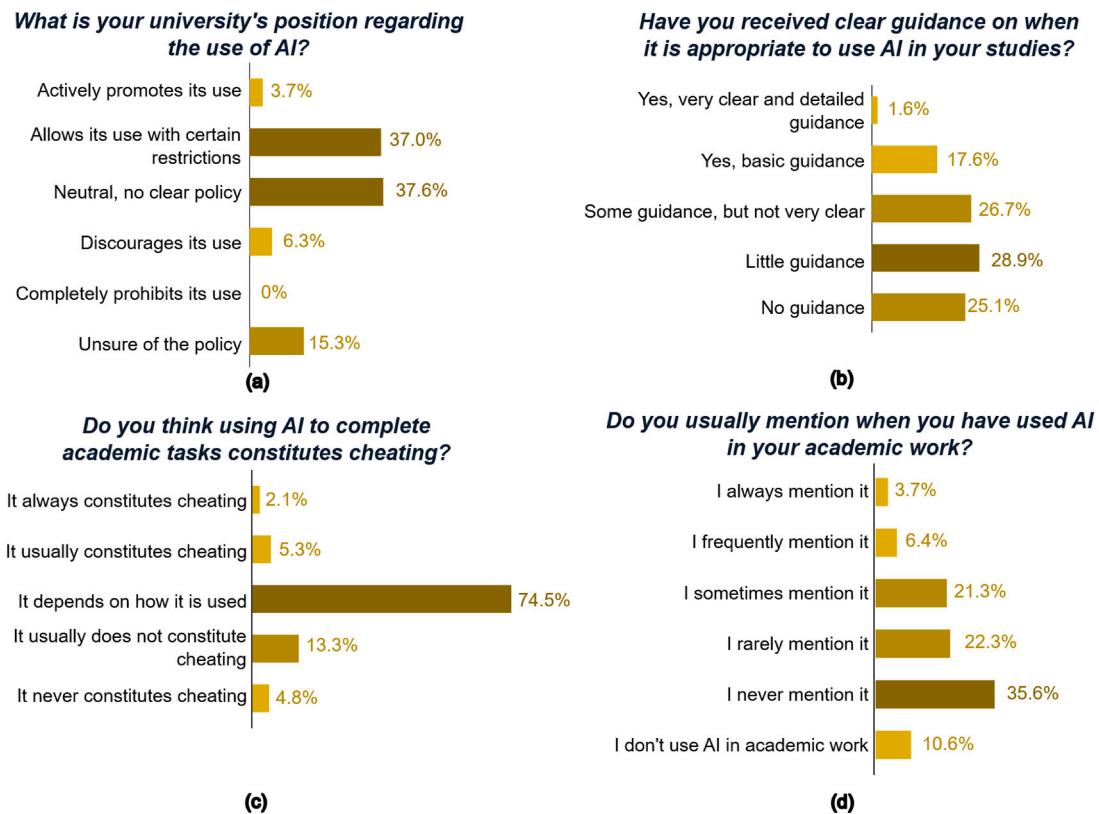


Figure 5. Institutional guidance and ethical use of AI among veterinary students: (a) perceived university position on AI use; (b) institutional guidance received; (c) perceptions of AI use as cheating; and (d) disclosure of AI use in academic work. Data are expressed as percentages; sample sizes vary slightly because of missing responses.

After adjustment for multiple comparisons using the Benjamini–Hochberg procedure, academic stage was significantly associated with the extent to which students reported acknowledging the use of AI in their academic work ($\chi^2 = 22.345$, $df = 5$, FDR-adjusted $p < 0.001$, Cramér's $V = 0.345$). Early-stage students more frequently reported acknowledging AI use only sometimes (30.9% vs. 11.0%), whereas advanced-stage students more frequently reported never acknowledging its use (46.2% vs. 25.8%). No statistically significant associations were observed between academic stage and the other ethical aspects evaluated after FDR correction (FDR-adjusted $p > 0.05$).

4.7. Future Expectations

Most students expected their use of AI to remain stable during the rest of their studies (60.4%, $n = 113$), although 37.4% ($n = 70$) anticipated a moderate or substantial increase. There was also strong support for additional AI training, with 71.7% of respondents indicating that they would probably or welcome further instruction on the ethical and effective use of AI. Students generally favored integrating AI into university curricula, particularly under specific conditions (40.1%, $n = 75$) or within selected courses (24.1%, $n = 45$), while only a minority opposed its inclusion. Furthermore, respondents anticipated a considerable impact of AI on their future profession, with 52.2% ($n = 97$) expecting a

significant but manageable effect and 8.1% ($n = 15$) predicting that AI would completely transform their profession (Figure 6).

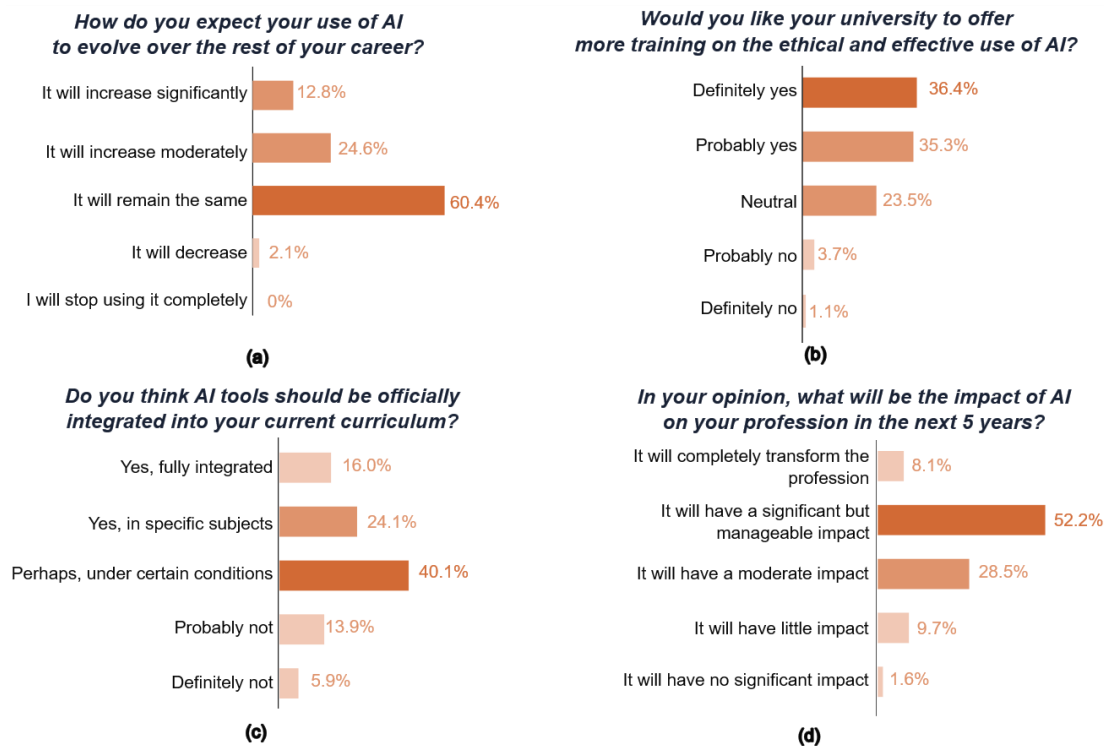


Figure 6. Future expectations regarding AI in veterinary education and professional practice: (a) expected evolution of AI use; (b) demand for additional university training; (c) integration of AI into the veterinary curriculum; and (d) expected impact on the veterinary profession. Data are expressed as percentages; sample sizes vary slightly because of missing responses.

No statistically significant associations were observed between academic stage and students' perspectives regarding the future role of AI after correction for multiple comparisons using the Benjamini–Hochberg FDR procedure, indicating that the future-oriented perceptions of AI assessed in this section were broadly comparable between early-stage and advanced-stage students.

4.8. Associations Between IA Variables and Gender

Potential gender-related differences across all variables concerning AI use, attitudes, perceptions, experiences, and expectations were also examined among women ($n = 149$) and men ($n = 40$). Although some associations reached nominal statistical significance in the initial analyses, none remained statistically significant after adjustment for multiple comparisons using the Benjamini–Hochberg procedure (FDR-adjusted $p > 0.05$). Likewise, no significant gender-related differences were identified for any of the individual response options from multiple-response questions after controlling the false discovery rate.

5. Discussion

The findings of the present study indicate that generative AI has become deeply integrated into the academic practices of veterinary students. Despite the limited availability of formal institutional training and policies, AI adoption was nearly universal among participants, suggesting that students engage with these technologies even in the absence of extensive structured educational support. As AI becomes increasingly relevant in veterinary education, understanding how students across different stages of the curriculum

perceive and use these tools is essential for identifying educational needs and informing evidence-based strategies for their responsible integration. Based on the current evidence, this study adds to the limited literature on generative AI in public veterinary education by examining veterinary students' knowledge, attitudes, and use of AI across different academic years.

5.1. Demographic and Academic Information

The study sample was predominantly composed of female veterinary students aged between 20 and 22 years, consistent with the well-documented feminization of veterinary education and the veterinary profession reported internationally [17,18]. This demographic profile is broadly consistent with previous AI-related surveys involving students in health and life sciences [1,2,6,9] and, more specifically, with a recent survey of veterinary students by de Brito et al., in which 82.8% of respondents were female and 84.5% were between 18 and 22 years of age [7]. Although differences in study populations and educational contexts should be considered, the similarity in age and gender distributions provides contextual support for the demographic profile observed in the present study.

Students from all five years were represented, providing perspectives from different stages of academic training. Although participation was not evenly distributed across academic years, which may partly reflect the convenience sampling strategy, the inclusion of 189 students (approximately 43% of the target population) provides an institution-specific overview of veterinary students' reported knowledge, use, perceptions, and attitudes toward AI. Nevertheless, because the study was conducted at a single veterinary school using non-probabilistic sampling, caution is warranted when extrapolating these findings to other educational settings.

5.2. Knowledge and Awareness of AI

The findings of the present study identified a potential gap between widespread AI use and the limited formal training available within the veterinary curriculum. Similar patterns have been described in other health-related disciplines and veterinary education, where students report increasing familiarity with AI despite receiving little structured educational preparation [6,7,9,14,15]. Together, these findings suggest that students' exposure to AI is developing faster than opportunities for formal training, highlighting the need for educational institutions to provide structured learning experiences that support the responsible and effective use of these technologies.

Although most participants reported familiarity with the basic principles of AI and correctly identified commonly used AI tools, nearly 60% reported having received no formal training. The coexistence of relatively high self-reported familiarity and limited formal instruction may indicate that familiarity with AI does not necessarily result from structured educational provision. This pattern is consistent with previous research in veterinary education, which reported that only 12.6% of veterinary students identified their faculty as their main source of practical information about AI, whereas 61.7% obtained such information from friends, family, or social networks; notably, 68.7% believed that veterinary faculties should provide AI training [7]. Similarly, Oropesa et al. [10], in a study of veterinary students from Spain and Portugal, reported limited formal AI training and identified self-directed learning as the most common source of AI knowledge. Importantly, students with previous AI training showed higher self-perceived knowledge and AI use, together with more positive attitudes toward educational applications of AI [10]. Although the populations and study contexts differed, these findings are broadly consistent with the pattern observed in the present study, supporting the need to provide structured educational opportunities rather than relying primarily on informal exposure to AI.

These findings reinforce the distinction between familiarity with AI tools and AI literacy as a broader educational competency. AI literacy extends beyond technical proficiency and includes understanding fundamental AI concepts, critically evaluating AI-generated outputs, recognizing biases and limitations, addressing ethical and privacy considerations, and integrating AI responsibly into professional decision-making [19–22]. Accordingly, veterinary curricula should move beyond introducing AI tools and instead prioritize the development of AI literacy as a broader educational competency. This distinction is also relevant beyond the student population. Li and Lai [11], in a study of veterinary professionals in China, reported high AI adoption despite limited familiarity among a substantial proportion of active users, with reliability and accuracy identified as major barriers and strong support for additional training. Although the professional population and national context differed from those of the present study, these findings provide a complementary perspective suggesting that frequent engagement with AI does not necessarily imply a corresponding level of familiarity or critical competence. This broader pattern further supports the importance of developing AI literacy during veterinary education, before students transition into professional practice.

5.3. AI Usage Patterns

The predominance of ChatGPT over other AI systems is also noteworthy. Although multiple AI platforms are currently available, ChatGPT was by far the preferred tool, whereas Claude, Perplexity, NotebookLM or DeepSeek showed lower adoption. This finding should not necessarily be interpreted as evidence of superior performance. It may partly reflect differences in accessibility, public visibility, and ease of use. However, the data does not allow these factors to be disentangled or compared with objective measures of platform performance. Google's Gemini showed substantially higher adoption than the other alternative platforms examined, indicating that students' use was not exclusively restricted to ChatGPT, although it remained clearly predominant. Previous studies in veterinary education have generally focused on overall AI use rather than providing detailed comparisons of specific AI platforms [7,17]. Thus, the present findings provide additional detail on the distribution of AI platform use among veterinary students, while the reasons underlying these preferences remain uncertain.

This concentration of use on a single general-purpose platform may also have implications for the development of broader AI competencies. Frequent use may provide practical familiarity, but exposure to a limited range of platforms may provide fewer opportunities to compare systems with different capabilities, limitations, and domain-specific applications. In this context, responsible AI use requires not only proficiency with a particular platform but also the ability to compare outputs across systems, recognize limitations and biases, and select appropriate tools according to the task and professional context. This consideration is particularly relevant in veterinary education, where future professionals may encounter increasingly specialized AI applications for diagnosis, clinical decision support, epidemiology, and other professional tasks.

The students primarily reported the use of AI as a cognitive support tool rather than as an automatic content generator. The marked difference between AI use in individual assignments and permitted online examinations may reflect differences in assessment context, including the greater emphasis on individual performance during examinations and possible concerns regarding academic integrity. However, these data do not allow us to determine whether institutional policies, assessment characteristics, or students' own ethical judgments were the primary determinants of this pattern. The most frequent applications included answering questions, searching for information, exam preparation, and brainstorming ideas, whereas programming and highly technical tasks were uncommon.

This usage profile is compatible with the information-intensive nature of veterinary education, which requires students to engage with large volumes of biomedical information, clinical reasoning, pathology, pharmacology, and diagnostic decision-making [4,7]. These findings suggest that students currently perceive AI as a learning support tool for information processing and academic preparation rather than for highly technical or disciplinary-specific tasks.

5.4. Perceptions and Attitudes

The overwhelmingly positive perception of AI represents another important finding of the present study. More than 90% of respondents perceived AI as beneficial for learning, with most students reporting improvements in conceptual understanding and study efficiency. Notably, perceived improvement in conceptual understanding (83.6%) was substantially more common than reported acquisition of new skills (47.4%). This discrepancy may reflect the predominant use of generative AI for clarifying concepts, summarizing information, completing assignments, and supporting examination preparation [7,9], rather than for authentic problem-solving, practical decision-making, or the development of discipline-specific competencies. Similar patterns have been reported among medical students, whose use of generative AI primarily involves academic and information-processing tasks, whereas its use for broader skill development appears less frequent [9]. Thus, although students may perceive AI as effective in supporting understanding, its role in active skill development appears less evident. This pattern may indicate that students more readily associate learning with understanding and knowledge acquisition than with the development of new competencies. It is important to note that this interpretation should be treated cautiously, as the questionnaire did not directly assess students' conceptions of learning. The prominence of time savings, improved comprehension, and personalized learning support is also consistent with previous studies highlighting the accessibility, immediate feedback, and explanatory capabilities of generative AI [4,5,7,9,23,24].

Nevertheless, the cross-sectional nature of the present study precludes determining whether these perceived benefits translate into objectively improved academic performance. Overall, these findings suggest that students generally perceive AI as beneficial for concept comprehension and study practices, whereas its contribution to skill acquisition and competency development remains less evident and warrants further investigation through longitudinal and outcome-based educational studies [7].

5.5. Institutional and Ethical Context

These findings revealed substantial uncertainty regarding institutional AI policies and guidance, accompanied by diverse perceptions of academic integrity and limited disclosure of AI use. Similar concerns have been reported among students in medicine, dentistry, and other health professions, where the rapid adoption of AI has frequently outpaced the development of clear institutional policies and formal educational frameworks [25–29]. This gap may contribute to uncertainty about acceptable uses of AI and difficulties in distinguishing legitimate academic support from inappropriate reliance on generative tools. Recent studies among medical students likewise highlight widespread academic use of generative AI together with the need for greater awareness and guidance regarding its responsible use [20,21]. Comparable findings have been reported among veterinary students, who strongly support university-led AI training, regulation, and the integration of AI-related competencies into the curriculum, while reporting limited knowledge of AI regulatory frameworks and a perceived need for further training in the ethical and responsible use of AI [7]. These concerns are further supported by recent proposals for veterinary AI literacy curricula, which emphasize that future veterinarians require not only technical knowledge

of AI systems but also training in ethical decision-making, transparency, critical appraisal of AI outputs, and understanding of professional responsibilities when using AI-assisted tools in clinical, educational, and research settings [30]. Taken together, these findings support the need for institutions to provide clear and practical guidance on acceptable uses, transparency, attribution, and academic integrity, while incorporating responsible AI literacy within veterinary education.

An important finding was the coexistence of optimism regarding the educational potential of AI and caution about its limitations. Although students recognized numerous benefits, they also expressed substantial concerns regarding misinformation, excessive dependence, and reduced critical thinking. Incorrect information was the most frequently reported concern, affecting more than 90% of respondents. This finding indicates that students recognize an important limitation of generative AI: its ability to generate plausible but inaccurate information (hallucinations) [20,28,29]. However, this awareness did not necessarily translate into consistent responsible practices. Despite recognizing the potential for inaccurate information, 57.9% of respondents reported that they never or rarely disclosed their use of AI in academic work. This discrepancy may reflect that awareness of AI-related risks and responsible AI behaviour may represent related but distinct dimensions of AI literacy. Students may understand that AI outputs require critical evaluation while remaining less aware of, or less consistent in applying, practices related to transparency and disclosure. This distinction is particularly important in veterinary education, where responsible AI use requires not only critical evaluation of generated information but also adherence to appropriate standards of transparency and academic integrity. Recent veterinary education research has shown that students strongly support the verification of AI-generated responses and favour transparency regarding AI use, indicating that trust in AI is closely linked to accountability and informed oversight [7].

The ethical dimension of AI further reinforces this distinction. Most respondents considered the acceptability of AI to depend on how it is used, rather than viewing its use as inherently acceptable or unacceptable. This nuanced perspective is consistent with the view that the ethical implications of AI depend largely on its purpose, degree of human involvement, transparency, and attribution [20,28]. Similar attitudes have been reported among healthcare students, who tend to consider AI more ethically acceptable when it supports learning than when it replaces independent intellectual effort or obscures authorship [8,25,26]. Veterinary students have expressed concerns regarding the ethical and responsible use of AI, the reliability of AI-generated outputs, and the need for appropriate regulation in educational settings [7]. However, the limited disclosure observed in the study suggests that recognizing the importance of responsible use does not necessarily translate into consistent implementation. Uncertainty regarding when and how AI use should be acknowledged may contribute to this discrepancy [21,26,27], although the cross-sectional design does not allow the underlying reasons for non-disclosure to be determined. Institutional policies should move beyond general statements and provide specific, practical guidance on acceptable use, disclosure, attribution, and academic integrity. In parallel, institutions should promote AI literacy through dedicated curricular content addressing ethical and legal considerations, critical evaluation of AI-generated outputs, transparency in AI-assisted work, and professional accountability in AI-supported decision-making [30]. Such measures could reduce ambiguity and support the development of responsible AI literacy among veterinary students [7], while aligning institutional practice with students' expressed expectations for formal training, regulation, and guidance on the ethical and effective use of AI technologies [20,21,28,30].

5.6. Future Expectations

The findings indicate that veterinary students expect AI to become an integral component of both their education and future professional practice. The strong support for additional AI training and the incorporation of AI-related competencies into veterinary curricula suggests that students recognize the growing importance of these technologies while also acknowledging the need to use them effectively, critically, and responsibly. At the same time, participants reported limited institutional guidance and unclear policies regarding AI use, highlighting a gap between the rapid adoption of AI and the availability of structured educational support. Notably, the strong demand for additional training may itself reflect an awareness that frequent use of AI does not necessarily imply adequate AI literacy. Thus, widespread adoption appears to coexist with a perceived need for more structured preparation, suggesting that familiarity with AI tools should not be equated with competence in their responsible use.

These findings reinforce the importance of considering AI literacy as a core professional competency rather than as simple technical proficiency. Beyond learning how to use AI tools, veterinary students should develop the ability to critically evaluate AI-generated information, recognize potential biases and limitations, understand ethical and regulatory implications, and apply AI responsibly in professional decision-making [19–21,30]. The strong demand for formal AI training observed in this study supports the integration of these competencies into veterinary education. Recent evidence from a large multinational cohort of veterinary students further supports these findings, showing that although AI tools are frequently used for academic purposes, many students report limited knowledge of AI regulations and discipline-specific applications [7]. Moreover, students consistently express a desire for formal training, institutional guidance, and clear policies governing AI use, highlighting the need for educational strategies that move beyond tool adoption and foster responsible, informed engagement with AI technologies.

The multidisciplinary nature of veterinary medicine may make AI particularly useful for information retrieval, literature synthesis, and evidence-based learning across diverse fields. However, because veterinary decisions can directly affect animal health, public health, food safety, and client trust, AI-generated outputs should be critically verified and interpreted within the context of professional expertise. The coexistence of positive attitudes towards AI and concerns about misinformation observed in this study may reflect an emerging recognition that the benefits of AI depend on appropriate human oversight. This interpretation is supported by evidence indicating that students strongly endorse the verification of AI-generated information, transparency regarding AI involvement, and the primacy of human judgement over AI-assisted recommendations, suggesting that AI is increasingly viewed as a supportive tool rather than a substitute for professional expertise. Future research should therefore move beyond self-reported perceptions and examine whether AI use translates into measurable educational and professional competencies. This could be achieved through larger, multi-institutional and longitudinal studies, more representative sampling strategies, objective assessments of AI literacy and educational outcomes, and the development and validation of standardized instruments specifically designed for veterinary students. Such approaches would provide stronger evidence to guide the integration of AI literacy into veterinary education and to determine whether perceived educational benefits translate into demonstrable competencies [20,28,29].

5.7. Associations Between IA Variables and Gender and Academic Stage

No statistically significant gender-related differences in AI use, perceptions, attitudes, experiences, or expectations were identified in the present study after correction for multiple comparisons using the Benjamini–Hochberg procedure, despite some nominal

associations in the initial analyses. This finding adds to the heterogeneous evidence regarding the influence of gender on AI engagement. Several studies have reported significant gender differences, although both their direction and magnitude vary across populations. Alharbi et al. (2026) [31] initially found greater AI experience, frequency of use, and comfort among women, although gender was no longer significant in their multivariable analysis. Conversely, other studies [26,32–35] reported greater AI readiness, knowledge, engagement, or more positive attitudes among men, with Møgelvang et al. (2025) [33] identifying gender as the strongest predictor of AI attitudes in multivariable analysis. Gender-specific differences have also been reported in AI knowledge, although these associations were not consistent across outcomes and, in some studies, were attenuated after adjustment for other covariates [5,9,32]. In contrast, the results of the present study are consistent with several studies reporting no significant overall gender-related differences in AI knowledge, perceptions, attitudes, or use [14,23,24,36,37], while gender was not highlighted as a major source of variation in the international study involving medical, dental, and veterinary students [6]. Altogether, the inconsistent findings across studies indicate that gender alone may have limited explanatory value and that observed differences may also reflect variation in educational setting, discipline, previous exposure to AI, technological experience, and sociocultural context.

However, significant differences according to academic stage were identified in the present study, particularly in patterns of AI use. Early-stage veterinary students reported more regular and daily AI use than advanced-stage students and were substantially more likely to have started using AI before entering university. They also reported greater use of Google Bard/Gemini and more frequent use of AI for examination preparation, solving mathematical problems, and resolving specific questions or doubts. Differences extended beyond usage patterns, as academic stage was also associated with changes in study methods, with advanced-stage students more frequently reporting that AI had not modified the way they studied. These findings are consistent with previous research showing more frequent and diverse generative AI use among individuals at earlier stages of their academic careers [37]; studies in medical and pharmacy students found greater AI knowledge at more advanced academic stages, including postgraduate, clinical-stage, and senior pharmacy students [5,9,32,33]. Conversely, several studies found no significant associations between age or academic year and AI-related knowledge, attitudes, readiness, anxiety, or use [23,24,26,31,35,36]. Overall, these contrasting findings suggest that differences in AI engagement across academic stages may reflect not only academic progression but also differences in previous exposure to generative AI. This may be particularly relevant in the present cohort, as 57.1% of early-stage students reported having started using AI before entering university, compared with only 5.7% of advanced-stage students. These findings may therefore reflect a cohort effect rather than academic progression alone, with more recent cohorts entering university after generative AI tools had already become widely accessible.

5.8. Study Limitations

The present study shows several limitations that should be acknowledged. First, the cross-sectional design precludes any causal inference between AI use, perceived learning benefits, and educational outcomes. In addition, the study relied on self-reported perceptions rather than objective measures of AI literacy, academic performance, or clinical reasoning, and therefore reflects students' subjective experiences rather than their actual competencies. Second, participation was voluntary and based on convenience sampling, with recruitment conducted through regular teaching activities. Consequently, students who were absent from these activities may have had less opportunity to participate, and

we could not ensure that all eligible students were directly exposed to the survey invitation. This may have resulted in self-selection and non-response bias. Although students from all academic years were represented, this study did not collect information from non-responders and therefore cannot determine whether participants differed systematically from non-participants. Students with greater interest in AI, greater familiarity with digital technologies, stronger academic engagement, or greater awareness of AI-related issues may have been more likely to participate, whereas students with limited interest in or exposure to AI may have been less inclined to respond. Such differences could potentially influence estimates of AI awareness, usage patterns, and attitudes. Third, the study was conducted at a single veterinary school in Spain, which limits the generalizability of the findings to other veterinary institutions, regions, and educational systems. Differences in curriculum structure, institutional policies, availability of AI training, digital resources, student characteristics, and cultural and regulatory contexts may influence students' knowledge, use, and perceptions of AI. Although participants from all years of the veterinary programme were represented, the distribution across academic years was uneven, with third-year students particularly underrepresented (6.3%, $n = 12$). This imbalance may partly reflect the convenience sampling strategy and recruitment through regular teaching activities and may limit the interpretation of year-specific patterns. Consequently, the findings should be considered an institution-specific characterization rather than representative of veterinary students more broadly. Multi-institutional studies involving veterinary schools from different regions and educational contexts are needed to assess the consistency and generalizability of these findings. Finally, grouping academic years into early and advanced stages improved statistical comparability but may have obscured differences between individual academic years.

6. Conclusions

Overall, this investigation indicates a potential gap between the widespread adoption of generative AI among students and the limited institutional guidance and formal training reported in the present study. Despite reporting extensive use of AI for learning activities, students also expressed concerns about potential risks, particularly misinformation, overreliance, and effects on critical thinking, while showing strong support for structured educational initiatives and clearer institutional policies. These findings suggest that the challenge facing veterinary education may increasingly concern not whether students will use AI, but how universities can support them in using these tools critically, ethically, and transparently. Integrating AI literacy into veterinary curricula may therefore represent an important step toward preparing future veterinarians for a professional environment in which AI-enabled tools are increasingly common. Future research should move beyond descriptive, cross-sectional surveys toward longitudinal and, where appropriate, intervention-based studies that evaluate whether structured AI training is associated with measurable changes in critical appraisal skills, academic performance, clinical reasoning, and ethical decision-making. Comparisons between students receiving structured AI literacy training and those following standard curricula, across institutions and academic years, would help identify evidence-based approaches for integrating AI competencies into veterinary education.

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