International Journal for Educational Integrity

RESEARCH Open Access

Artificial intelligence usage and ethical concerns among Jordanian University students: a cross-sectional study

Marwa M. Alnsour[1,2*], Hamzeh Almomani[1], Latifa Qouzah[3], Mohammad Q.M. Momani[4], Rasha A. Alamoush[1,2] and Mahmoud K. AL-Omiri[1,2]

*Correspondence:
Marwa M. Alnsour
Ma_alnsour@ju.edu.jo
[1]The University of Jordan, Amman, Jordan
[2]Jordan University Hospital, Amman, Jordan
[3]Jordan University of Science and Technology, Irbid, Jordan
[4]Hashemite University, Zarqa, Jordan

Abstract

Background This study explores the ethical implications of AI-driven natural language generation systems such as ChatGPT in university education from the perspective of students in Jordanian universities. The specific objectives of this study are to assess students' awareness and utilization of AI, explore ethical considerations, evaluate institutional support, and determine needs for future training.

Methods A cross-sectional survey of university students from various disciplines at Jordanian universities was conducted. Participants provided demographic data and responded to questions on AI use, knowledge, ethical considerations, institutional support, and future training needs. Statistical analyses included descriptive statistics, Chi-square tests, Mann–Whitney U tests, and regression analyses.

Results A total of 885 university students participated in the study, including 517 females and 368 males, aged 18–55 years (mean ± SD = 21.5 ± 3.1 years). Most participants (78.1%) reported using AI tools during their studies, primarily for answering academic questions (53.9%) and completing assignments (46.4%). While over half considered themselves moderately to very knowledgeable about AI, awareness of ethical guidelines was limited. Students generally viewed AI use for tasks such as translation, literature reviews, and exam preparation as ethically acceptable, whereas using AI to cheat or fully complete assignments was widely regarded as unacceptable. Significant differences in AI knowledge, usage, and ethical awareness were observed across gender, academic level, and field of study ($p < 0.05$). Notably, 76.7% of participants expressed interest in receiving professional training on the responsible use of AI in education.

Conclusions Jordanian university students demonstrate high levels of AI usage and moderate self-reported knowledge. While many recognize the ethical risks of AI in education, their familiarity with specific ethical principles and institutional guidelines remains limited. Notable differences across gender, academic level, and field of study highlight the need for targeted educational support.

Keywords AI, Artificial intelligence, Natural language generation, Generative AI, Education, Ethics, University students, Higher education, Cross-sectional survey

Introduction

AI-driven natural language generation (NLG) models are artificial intelligence (AI) algorithms designed to enable computers to understand, generate, and interact with human language (OECD 2023). Prominent examples include ChatGPT and Gemini. These models are widely applied in domains such as healthcare, education, and business administration, where they support users by answering questions and providing explanations (Liu et al. 2021; Mizumoto and Eguchi 2023; Linkon et al. 2024; Alnsour et al. 2025a).

Generative AI technologies, such as ChatGPT, have become integral tools in modern education, offering students a range of applications to enhance their learning experiences. These tools assist learners in organizing tasks, summarizing readings, and personalizing study materials to fit individual needs (Alnsour et al. 2025b). Beyond administrative support, students utilize AI for proofreading and refining academic writing, conducting literature search, synthesizing information for research projects, and generating or debugging code for assignments (Huang and Rust 2018; Sok and Heng 2023). Moreover, AI applications extend to language learning, data analysis, idea generation for projects, and preparing for assessments through interactive quizzes or practice questions. Collectively, these features enable students to work more efficiently, develop a deeper understanding, and strengthen their academic performance.

The use of AI in education by students, while useful and powerful, comes with several risks that need to be carefully managed. Inaccurate information is a significant concern, as these models can sometimes generate incorrect or misleading content (Sok and Heng 2023; Baidoo-Anu and Ansah 2023). Furthermore, over-reliance or dependence on AI tools may negatively impact critical thinking and problem-solving skills, potentially hindering students' development of essential competencies (Sok and Heng 2023; Kasneci et al. 2023; Mhlanga 2023).

Furthermore, AI can enable academic dishonesty and plagiarism by generating or granting access to unoriginal content, challenging academic integrity (Halaweh 2023). Academic honesty is compromised when students use AI to complete assignments or essays, submitting work that is not their own. Issues of fairness and equity further complicate AI integration, as not all students have equal access to AI tools, creating disparities in academic outcomes (Halaweh 2023). Questions about intellectual property and ownership also arise, as it is unclear who owns AI-generated content or whether it is ethical to present it as original work (Gottschalk and Weise 2023).

As the influence of AI in education continues to grow, addressing these risks becomes imperative to ensure a fair, equitable, and ethically sound learning environment. Efforts to establish ethical guidelines for AI in education are diverse and evolving globally. UNESCO promotes rights-based approaches, emphasizing fairness, transparency, and accountability in AI use (UNESCO 2021). Similarly, the European Commission has developed AI guidelines with specific recommendations for educational settings to uphold fundamental rights and ethical standards (European Commission 2019). However, universal guidelines face challenges due to diverse educational systems and cultural contexts worldwide. What may work effectively in one country may not be suitable in another because of differences in educational policies, technological infrastructure, and social values. Additionally, implementations remain voluntary and vary by country, raising concerns about consistency and potential gaps in maintaining ethical standards in education globally (Pedro et al. 2019).

In Jordan, national AI initiatives like the Jordan National AI Strategy and the Digital Transformation Strategy (2023–2027) demonstrate a commitment to advancing AI technologies, yet ethical guidance specific to education remains limited (Jordan Ministry of Digital Economy and Entrepreneurship 2022). Most research on AI in education has focused on North America, Europe, and East Asia, with few studies examining students' perspectives, who are the primary users of AI tools (Monasterio Astobiza et al. 2022; Holmes et al. 2022). Understanding students' awareness, usage patterns, and ethical concerns locally can inform university policies and curricula tailored to Jordan's cultural and educational context. At a regional level, insights from Jordan may guide other local countries facing similar challenges in equitable AI access, academic integrity, and culturally sensitive AI integration. Internationally, including data from underrepresented regions enhances global understanding of AI ethics in higher education, supporting more inclusive and universally applicable guidelines.

Therefore, this study aims to assess the ethical implications of AI-driven language models, such as ChatGPT, among Jordanian university students. It examines students' awareness of ethical concerns, experiences with unethical AI use, perceptions of institutional support, and expressed needs for future training.

Methodology

Participants and sample size calculation

Students from various universities across Jordan participated in the survey. The sample size was calculated using G*Power software (version 3.1.9.7; Heinrich-Heine University). A priori power analysis for logistic regression (z tests) determined a re-quired sample of 721 participants, based on an odds ratio of 1.3, an alpha error of 0.05, and a study power (1–β) of 0.8.

Data collection instrument and validation

The survey instrument was developed following a comprehensive literature review on AI use and ethics in education and adapted from a previous study by (Alnsour et al. 2025b) on academic staff. The survey consisted of 26 questions (Supplementary File 1) designed for quantitative analysis, covering demographic information and four key domains of students' engagement with AI in higher education:

Section 1: Awareness and usage of AI (score range: 0–23).
Section 2: Ethical considerations of AI use (score range: 0–42).
Section 3: Perceptions of institutional support (score range: 0–4).
Section 4: Future training needs (score range: 0–3).

Responses were recorded on a Likert scale (0–4) or as binary items (yes = 1, no = 0). Section scores were calculated as the sum of individual item scores, and the overall knowledge score ranged from 0 to 72.

Survey development involved three investigators, who drafted and refined items to ensure relevance and non-redundancy. The draft instrument was subsequently reviewed by two independent academic experts with experience in AI use in higher education. They evaluated the suitability and coverage of the items, provided feedback for revisions, and formally endorsed the final version.

A pilot study with 40 students was then conducted to test clarity, relevance, and effectiveness. Reliability analysis indicated strong internal consistency: Cronbach's alpha was 0.798 for section scores ($F = 4.962$, $p < 0.001$), 0.839 for individual items ($F = 6.208$, $p < 0.001$), and 0.844 when sections and items were combined ($F = 6.411$, $p < 0.001$). Following the pilot, the validated survey was finalized and distributed to participants for the main study.

Ethical approval

The study has obtained ethical approval from the University of Jordan Institutional Review Board (IRB) (Reference: 247/2024).

Data collection

Participants were invited via social media platforms, and the data collection period was set for 3 months (13 July-13 September).

Statistical analysis

Data was analyzed using IBM SPSS Statistics v20.0 (IBM Corp., USA). Descriptive statistics, including frequencies and percentages, summarized categorical variables (e.g., gender, education level, major school category, and item responses regarding AI knowledge and awareness). Continuous variables (age, section scores, and total AI knowledge score) were summarized using medians, interquartile ranges, and ranges due to non-normal distribution (Kolmogorov-Smirnov test). Reliability of the survey was assessed with Cronbach's alpha for both the pilot and main study.

Associations between categorical variables and survey responses were analyzed using the Chi-square test, with effect sizes calculated using Phi, Cramer's V, or Eta where appropriate. Differences in total and section scores by gender were assessed with the Mann–Whitney U test, while variations by academic degree and major school category were evaluated using the Kruskal–Wallis test, followed by pairwise Mann–Whitney U comparisons. Spearman's rho correlation tested associations between age and total or section scores.

Multiple linear regression analyses examined the predictive value of demographic variables on total, section, and individual item scores for AI knowledge and ethical awareness. Multiple logistic regression analyses were conducted to assess the influence of demographic factors on dichotomous outcomes, such as prior AI use, observed unethical AI use, and interest in receiving training on ethical AI use. A two-tailed significance level of $\alpha = 0.05$ and 95% confidence intervals were applied throughout.

Results

Participants characteristics

Data from 885 participants were analyzed, including 517 females (58.4%) and 368 males (41.6%). Ages ranged from 18 to 55 years (mean ± SD = 21.5 ± 3.1; median = 21.0; IQR = 2; variance = 9.4). Most participants were undergraduate students (91.9%), with smaller proportions enrolled in master's (5.3%) and doctoral programs (2.8%). Academic fields represented included health sciences (57.1%), humanities (26.7%), and science/engineering (16.3%). Table 1 summarizes the demographic characteristics of the sample. The

Table 1 Distribution of demographic variables and total and section scores of knowledge and awareness of AI use in education among the study population ($n=885$)

Variables	Category (n, %)	Statistic	Total AI knowledge score	Section score for general awareness of AI use	Section score for ethical awareness of AI use	Section score for institutional support of AI use	Section score for interest in training on ethical AI use
Gender	Female (517, 58.4)	Mean	29.65	9.38	17.73	1.66	0.89
		SD	8.346	3.622	6.277	1.048	0.562
		Median	29.00	9.00	17.00	2.00	1.00
		IQR	12	5	9	1	0
		Min	6	0	3	0	0
		Max	60	22	37	4	3
	Male (368, 41.6)	Mean	28.83	9.55	16.67	1.73	0.88
		SD	8.667	3.785	6.181	1.245	0.587
		Median	28.00	10.00	16.00	2.00	1.00
		IQR	12	5	9	2	0
		Min	4	0	0	0	0
		Max	56	21	36	4	2
Level of education	BDS (813, 91.9)	Mean	29.34	9.44	17.35	1.66	0.89
		SD	8.404	3.691	6.187	1.132	0.571
		Median	29.00	9.00	16.00	2.00	1.00
		IQR	12	5	8	1	0
		Min	4	0	0	0	0
		Max	60	22	37	4	3
	MSc (47, 5.3)	Mean	28.68	9.36	16.57	1.85	0.89
		SD	8.343	3.460	6.265	1.103	0.598
		Median	27.00	9.00	15.00	2.00	1.00
		IQR	10	5	8	2	0
		Min	6	2	3	0	0
		Max	48	17	33	4	2
	PhD (25, 2.8)	Mean	29.56	9.88	16.60	2.28	0.80
		SD	11.351	4.177	8.327	1.100	0.577
		Median	27.00	10.00	16.00	2.00	1.00
		IQR	16	6	12	2	1
		Min	13	4	5	1	0
		Max	58	19	37	4	2

Table 1 (continued)

Variables	Category (n, %)	Statistic	Total AI knowledge score	Section score for general awareness of AI use	Section score for ethical awareness of AI use	Section score for institutional support of AI use	Section score for interest in training on ethical AI use
Major school category	Humanities (236, 26.7)	Mean	26.63	8.57	15.05	2.13	0.89
		SD	7.867	3.310	5.820	1.138	0.505
		Median	25.00	8.00	13.00	2.00	1.00
		IQR	9	5	6	2	0
		Min	6	0	3	0	0
		Max	55	18	37	4	2
	Health (505, 57.1)	Mean	30.21	9.60	18.28	1.43	0.91
		SD	8.348	3.739	6.146	1.061	0.591
		Median	30.00	10.00	18.00	1.00	1.00
		IQR	11	5	9	1	0
		Min	6	0	6	0	0
		Max	60	22	37	4	3
	Science (144, 16.3)	Mean	30.53	10.36	17.51	1.86	0.81
		SD	9.033	3.835	6.428	1.126	0.606
		Median	30.00	10.50	17.00	2.00	1.00
		IQR	13	5	8	2	1
		Min	4	2	0	0	0
		Max	56	21	36	4	2

AI = Artificial intelligence language models, SD = Standard deviation, IQR = Interquartile range, Min = Minimum value, Max = Maximum value

instrument demonstrated acceptable reliability, with Cronbach's Alpha values of 0.771 for section scores, 0.792 for individual items, and 0.835 for combined scores ($p < 0.001$).

General awareness and usage of AI language models

Approximately 78.1% ($n = 691$) of participants reported having used AI during their university studies. About half of them used AI on a weekly or daily basis, while 6% had never used it (Table 2). Participants from humanities schools reported the lowest usage, whereas those from science and engineering schools reported the highest ($p < 0.05$, Table 3).

Regarding knowledge, 13.7% of participants considered themselves very knowledgeable, while 43.8% reported moderate knowledge of AI use in academia. Females and humanities students were the least knowledgeable, while males and students from science and engineering schools were the most knowledgeable ($p < 0.05$, Table 3). The most common purposes for using AI included answering academic questions (53.9%) and completing assignments (46.4%). ChatGPT was the most frequently used AI language tool (85.2%) (Table 2).

Ethical use of AI language models

Approximately 35% of participants expressed concern or strong concern about the ethical use of AI by students. Females and health sciences students were more concerned than males and humanities students ($p < 0.05$, Table 3).

The academic tasks most frequently considered ethically acceptable included:

- Translation and proofreading (72%)

Table 2 Descriptive statistics and differences in responses to individual items related to knowledge and awareness of AI use in academic field among the study participants (*n*=885)

Sections and items	Response	n	%	$^{\$}X^2$	P
General awareness and usage of AI language models					
2.1. Level of Knowledge of AI use in academic work	Not knowledgeable at all	20	2.3	440.260	< 0.001
	Not very Knowledgeable	125	14.1		
	Neutral	231	26.1		
	Moderately knowledgeable	388	43.8		
	Very knowledgeable	121	13.7		
2.2. First source to know about AI	Personal exploration	70	7.9	534.177	< 0.001
	Friend or Family	257	29.0		
	Social media	488	55.1		
	Academic sources	70	7.9		
2.3. Used AI in university before	No	194	21.9	279.106	< 0.001
	Yes	691	78.1		
2.4. Frequency of using AI in academic work	Never	53	6.0	171.243	< 0.001
	Rarely	242	27.3		
	Monthly	175	19.8		
	Weekly	274	31.0		
	Daily	141	15.9		
2.5. Purposes of using AI in academic field[#]	Writing assignments	411	46.4	4.485	0.034
	Generate project ideas	342	38.6	45.651	< 0.001
	Summarize academic material	299	33.8	93.072	< 0.001
	Translation	296	33.4	97.005	< 0.001
	Proofreading	196	22.1	274.632	< 0.001
	Create presentations	159	18.0	363.264	< 0.001
	Research and data analysis	147	16.6	394.668	< 0.001
	Answer questions during study	477	53.9	5.380	0.020
	I do not use it	40	4.5	732.232	< 0.001
2.6. The used AI language[#]	ChatGPT	754	85.2	438.564	< 0.001
	Gemini	135	15.3	427.373	< 0.001
	T5	43	4.9	721.357	< 0.001
	Copilot	30	3.4	769.068	< 0.001
	RoBERTa	151	17.1	384.055	< 0.001
	Others	18	2.0	814.464	< 0.001
	Never used any language	55	6.2	678.672	< 0.001
Ethical use of AI language models by students					
3.1. Have ethical concerns regarding students use of AI in academia	Not concerned at all	55	6.2	330.531	< 0.001
	Not concerned	161	18.2		
	Neutral	361	40.8		
	Concerned	219	24.7		
	Very concerned	89	10.1		
3.2. Ethically acceptable academic activities for students to use AI[#]	Writing	317	35.8	71.188	< 0.001
	Translation and proofreading	637	72.0	170.984	< 0.001
	Data analysis	402	45.4	7.414	0.006
	Literature review	462	52.2	1.719	0.190
	Exam preparation	359	40.6	31.513	< 0.001
	Presentations	315	35.6	73.475	< 0.001
	Programming and coding	301	34.0	90.496	< 0.001
3.3. Ethically unacceptable activities for students to use AI[#]	Cheating and total dependence on AI	70	7.9	627.147	< 0.001

Table 2 (continued)

Sections and items	Response	n	%	X^2	P
3.4. Observed unethical AI use by students before	No	533	60.2	37.018	< 0.001
	Yes	352	39.8		
3.5. The observed unethical AI use by students #	Cheating and total dependence on AI	141	15.9	410.858	< 0.001
	Stealing identity of others	4	0.5	869.072	< 0.001
3.6. Students require guidance on ethical AI use in academia	Strongly disagree	5	0.6	748.158	< 0.001
	Disagree	19	2.1		
	Neutral	121	13.7		
	Agree	359	40.6		
	Strongly agree	381	43.1		
3.7. Measures to ensure proper ethical AI use in education#	Ban AI in education	122	13.8	464.272	< 0.001
	Restrict based on needs	305	34.5	85.452	< 0.001
	Train & workshops on ethical use	532	60.1	36.205	< 0.001
	Clear guidelines for acceptable AI use	438	49.5	0.092	0.762
	Integrate ethics to curriculum	323	36.5	64.544	< 0.001
	Define policy and monitor compliance	280	31.6	119.350	< 0.001
	Share & promote ethical AI use examples	353	39.9	36.205	< 0.001
	Have alternative resources, AI is supplement	408	46.1	5.380	0.020
	Have confidential reporting system of misuse	250	28.2	167.486	< 0.001
4.1. Familiarity with current ethical guidelines/ policies for AI use in academia	Not familiar at all	66	7.5	199.514	< 0.001
	Somewhat familiar	185	20.9		
	Neutral	247	27.9		
	Not very familiar	287	32.4		
	Very familiar	100	11.3		
4.2. Awareness of ethical principles for using AI in education#	Not aware	370	41.8	23.757	< 0.001
	Fairness and Inclusivity	192	21.7	283.617	< 0.001
	Equitable Access and Avoid Discrimination	219	24.7	225.773	< 0.001
	Beneficence	316	35.7	72.327	< 0.001
	Non-maleficence	267	30.2	139.210	< 0.001
	Transparency	192	21.7	283.617	< 0.001
	Privacy and informed consent	156	17.6	370.993	< 0.001
	Data Security and Integrity	203	22.9	259.255	< 0.001
	Freedom and Autonomy	164	18.5	350.564	< 0.001
	Accountability and responsibility	145	16.4	400.028	< 0.001
	Promoting accuracy	175	19.8	323.418	< 0.001
	No substitute for human teacher/interaction	203	22.9	259.255	< 0.001
4.3. Source of information for AI ethical guidelines and principles#	None	357	40.3	33.041	< 0.001
	Internet browsing	181	20.5	309.072	< 0.001
	Articles and Journals	59	6.7	664.733	< 0.001
	Courses	49	5.5	699.852	< 0.001
	Social media	159	18.0	363.264	< 0.001
	Authorities guidelines	80	9.0	593.927	< 0.001
Institutional support and awareness					
5.1. Support by institution for ethical AI use in academic field	Strongly disagree	137	15.5	189.322	< 0.001
	Disagree	275	31.1		
	Neutral	269	30.4		
	Agree	138	15.6		
	Strongly agree	66	7.5		
Future training and development					

Table 2 (continued)

Sections and items	Response	n	%	$^{\$}X^2$	P
6.1. Interested in training for ethical use of AI in academia	No	206	23.3	252.801	< 0.001
	Yes	679	76.7		
6.2. Topics to cover about AI ethics and AI use in future training[#]	AI use in writing and assignments without total dependence on AI	69	7.8	630.519	< 0.001
	AI use in student field of study	36	4.1	746.858	< 0.001

AI = Artificial intelligence language models, X^2 = Chi square statistic, *p* = Probability value. [#]Yes responses are presented. [$]Degree of freedom equals 4 for items 2.1, 2.4, 3.1, 3.6, 4.1, and 5.1 (expected *n* = 177.0); equals 3 for item 2.2 (expected *n* = 221.3); and equals 1 for the rest of the items (expected *n* = 442.5)

- Literature reviews (52.2%)
- Data analysis (45.4%)
- Exam preparation (40.6%)

Cheating and total dependence on AI were considered ethically unacceptable by 7.9% of participants. Additionally, 39.8% reported witnessing unethical use of AI, with females and students from science and engineering programs more likely to report such observations ($p < 0.05$, Table 3).

Regarding awareness of existing policies, 44% reported familiarity with ethical guidelines, while 41.8% were unaware of any principles guiding AI use. Among those aware, beneficence (35.7%) and non-maleficence (30.2%) were the most frequently recognized principles. Females and health sciences students were less familiar with these guidelines ($p < 0.05$, Table 3).

Institutional support and future training needs

A large majority of participants (83.7%) agreed that guidance on ethical AI use in education is necessary. Suggested measures included training and workshops (60.1%) and clear ethical guidelines (49.5%). 46.6% indicated that their institutions had not provided adequate support for ethical AI use. Approximately 76.7% of participants expressed interest in receiving professional training on the ethical use of AI in education (Table 2). The most suggested training topics included using AI for writing and assignments without total dependence (7.8%) and applying AI in the participants' specific fields of study (4.1%). Humanities students were more likely to express interest in such training ($p < 0.05$, Table 3).

Group differences in AI knowledge and ethical awareness

Table 4 displays descriptive statistics and demographic-based differences in total and section scores. Females demonstrated greater ethical awareness than males ($p < 0.05$); older participants had higher total knowledge, greater ethical awareness, and more interest in future training on ethical AI use ($p < 0.05$). Academic level was significantly associated with awareness of institutional roles (Kruskal–Wallis test: χ^2 (2) = 7.3, $p = 0.026$), with PhD students more aware than BDS students (Mann–Whitney $U = 7249.5$, $z = -2.528$, $p = 0.011$). Field of study was also linked to overall AI awareness and section scores ($p < 0.05$), except for interest in training (χ^2 (2) = 3.728, $p = 0.155$); post hoc comparisons indicated that humanities students had lower awareness than health sciences

Table 3 Associations between demographic factors and the items regarding knowledge and awareness of AI use in academic field among the study population ($n=885$)

Item	Gender			Age			Education level			Major school category		
	X^2	df	P	X^2	Df	P	X^2	Df	P	X^2	df	P
2.1. Level of Knowledge of AI use in academic work	34.808 C = 0.198	4	< 0.001	123.587 E = 0.179	92	0.016	11.451	8	0.177	19.327 C = 0.104	8	0.013
2.2. First source to know about AI	22.635 C = 0.160	3	< 0.001	74.971	69	0.291	10.843	6	0.093	41.875 C = 0.154	6	< 0.001
2.3. Used AI in university before	2.901	1	0.089	29.578	23	0.162	1.572	2	0.456	11.278 C = 0.113	2	0.004
2.4. Frequency of using AI in academic work	6.770	4	0.149	93.652	92	0.432	9.334	8	0.315	25.089 E = 0.146	8	0.002
2.5. Total score of purposes to use AI	8.570	8	0.380	201.240	184	0.182	18.816	16	0.278	70.616 E = 0.206	16	< 0.001
3.1. Concerned ethically about students use of AI in academic field	11.861 E = 0.116	4	0.018	106.979	92	0.136	11.810	8	0.160	17.041 C = 0.098	8	0.030
3.2. Total score of ethically acceptable academic activities for students to use AI	19.332 E = 0.148	7	0.007	149.087	161	0.740	14.131	14	0.440	126.648 E = 0.265	14	< 0.001
3.3. Ethically unacceptable activities for students to use AI	2.382	1	0.123	5.849	23	1.00	3.239	2	0.198	5.833	2	0.054
3.4. Observed AI use by students that caused ethical concerns	5.371 PH = 0.078	1	0.020	23.764	23	0.417	0.439	2	0.803	7.386 C = 0.91	2	0.025
3.6. Students should have guidance on ethical AI use	5.283	4	0.260	62.500	92	0.992	16.645 E = 0.131	8	0.034	14.980	8	0.060
3.7. Total score of measures to ensure proper ethical AI use	11.930	9	0.217	230.603	207	0.125	10.697	18	0.907	92.463 E = 0.247	18	< 0.001

Table 3 (continued)

Item	Gender			Age			Education level			Major school category		
	X^2	df	P	X^2	Df	P	X^2	Df	P	X^2	df	P
4.1. Familiarity with current ethical guidelines/policies for AI use in academia	13.147 C = 0.122	4	0.011	85.735	92	0.664	14.601	8	0.067	52.068 E = 0.232	8	< 0.001
4.2. Not aware of ethical principles for using AI in education	1.600	1	0.206	13.900	23	0.930	0.077	2	0.962	0.309	2	0.857
4.2. Total score for ethical principles for using AI in education	16.127	11	0.136	409.364 E = 0.216	253	0.000	19.407	22	0.620	78.276 E = 0.191	22	< 0.001
4.3. No information source for AI ethical principles	2.995	1	0.084	18.845	23	0.710	9.632 C = 0.104	2	0.008	18.474 C = 0.144	2	< 0.001
5.1. Support by institution for ethical AI use	22.196 E = 0.158	4	< 0.001	125.788 E = 0.225	92	0.011	15.987 E = 0.116	8	0.043	73.444 E = 0.272	8	< 0.001
6.1. Interested in training for ethical use of AI	1.047	1	0.306	24.401	23	0.382	0.323	2	0.851	6.616 C = 0.086	2	0.037

AI = Artificial intelligence language models, X^2 = Chi square statistic, df = Degree of freedom, *p* = Probability value. C = Cramer's V statistic, E = Eta statistic, PH = Phi statistic

and science/engineering students, while science and engineering students showed the highest general awareness and understanding of institutional support ($p < 0.05$). Furthermore, participants with higher AI knowledge (item 2.1) were more familiar with ethical guidelines ($\rho = 0.253$, $p < 0.001$) and had higher ethical awareness ($\rho = 0.147$, $p < 0.001$). Frequent AI users were also more familiar with ethical guidelines ($\rho = 0.141$, $p < 0.001$) and demonstrated higher ethical awareness ($\rho = 0.220$, $p < 0.001$). Finally, prior AI users scored higher in both familiarity with ethical guidelines (χ^2 (4) = 12.191, $p = 0.016$, Cramer's V = 0.117) and ethical awareness (χ^2 (34) = 100.525, $p < 0.001$, $\eta = 0.337$).

Predictors of AI knowledge and ethical awareness

Regression analyses examined demographic predictors of AI knowledge, ethical awareness, perceived institutional support, and future training needs Tables (5, 6, 7). Being male, younger, holding a lower academic degree, or studying in the humanities was associated with lower AI knowledge and ethical awareness ($p < 0.05$). Females had 1.2 times higher total AI knowledge ($p = 0.033$) and 1.3 times higher ethical awareness ($p = 0.002$). Each additional year of age corresponded to increases in total AI knowledge (0.24, $p = 0.011$) and ethical awareness (0.22, $p = 0.002$), a slight decrease in perceived

Table 4 The demographic-based differences and descriptive statistics for total awareness and knowledge of AI use scores, as well as for each section's scores, among the study population ($n = 885$)

Variable	Descriptive statistics		Gender (MWU, P)	Age (Rho, P)	Level of education (X^2, P)	School category (X^2, P)	[$] Pairs of school categories (MWU, P)
Total AI knowledge score	**Mean ±SD**	**29.31 ±8.49**	**90662.5, 0.233**	**0.075, 0.025**	**0.525, 0.769**	**40.360, <0.001**	**1Vs2: 43,098.0, < 0.001** **1Vs3: 12,149.5, < 0.001** **2Vs3: 35,832.0, 0.790**
	Median	**29.00**					
	IQR	**12**					
	Range	**4–60**					
Section score for general awareness of AI use	Mean ±SD	9.45 ±3.69	91931.0, 0.392	0.045, 0.179	0.216, 0.897	26.233, <0.001	1Vs2: 48,917.0, <0.001 1Vs3: 11,995.0, <0.001 2Vs3: 32,241.0, 0.037
	Median	9.00					
	IQR	5					
	Range	0–22					
Section score for ethical considerations for AI use by students	Mean ±SD	17.29 ±6.26	86245.0, 0.018	0.081, 0.016	1.934, 0.380	54.548, <0.001	1Vs2: 39,707.5, <0.001 1Vs3: 12,471.5, <0.001 2Vs3: 33,684.0, 0.177
	Median	16.00					
	IQR	9					
	Range	0–37					
Section score for institutional support and awareness regarding AI use	Mean ±SD	1.68 ±1.13	92853.0, 0.530	0.106, 0.002	7.300, 0.026	67.678, <0.001	1Vs2: 38,850.5, <0.001 1Vs3: 14,802.5, <0.001 2Vs3: 28,193.5, <0.001
	Median	2.00					
	IQR	1					
	Range	0–4					
Section score for future training and development regarding ethical AI use	Mean ±SD	0.89 ±0.57	93580.5, 0.620	0.083, 0.014	0.576, 0.750	3.728, 0.155	1Vs2: 58,764.0, 0.712 1Vs3: 15,681.5, 0.123 2Vs3: 33,224.0, 0.063
	Median	1.00					
	IQR	0					
	Range	0–3					

AI = Artificial intelligence language models, SD = Standard deviation, IQR = Interquartile range, MWU = Mann Whitney U test statistic, Rho = Spearman correlation coefficient, X^2 = Chi square statistic using Kruskal Wallis test at degree of freedom equals to 2, p = Probability value. [$] School categories are humanities (1), health sciences (2), and Science and Engineering (3)

institutional support (−0.03, $p = 0.009$), and increased interest in AI training (0.02, $p = 0.002$). Humanities students had 2.3 times lower total AI knowledge ($p < 0.001$), 1.66 times lower ethical awareness ($p < 0.001$), but 0.22 times higher perception of institutional support ($p < 0.001$).

Odds of prior AI use were lower among humanities students (OR = 0.526, $p = 0.014$). Being male (OR = 0.741, $p = 0.038$) or studying humanities (OR = 0.593, $p = 0.018$) was associated with lower odds of observing unethical AI use. Older participants (OR = 1.098, $p = 0.018$) and humanities students (OR = 1.732, $p = 0.028$) were more likely to express interest in ethical AI training.

Higher AI knowledge was positively associated with concern about students' ethical AI use, familiarity with AI ethical guidelines, and overall ethical awareness ($p < 0.001$). Each unit increase in knowledge increased concern scores by 0.089 ($p = 0.05$), familiarity with guidelines by 0.278 ($p < 0.001$), and ethical awareness by 1.023 ($p < 0.001$).

Discussion

This study assesses Jordanian university students' engagement with generative AI, focusing on their awareness and knowledge, ethical considerations, and their perceived needs for future training, alongside the role of institutions in providing guidance.

General awareness and usage of AI language models

This study revealed a high prevalence of AI language model usage among Jordanian university students: 78.1% reported using AI in academic activities, with about half using it frequently (daily or weekly), highlighting the growing role of tools like ChatGPT in education (Nguyen 2023; Alnsour et al. 2025b). Students in science and engineering disciplines were the most frequent users, whereas humanities students reported lower usage, reflecting broader trends in which STEM fields, being more reliant on technical tools, adopt new technologies more rapidly (Hajkowicz et al. 2023; Stöhr et al. 2024).

STEM students primarily use AI for tasks such as data analysis, simulations, and coding, while humanities students focus on interpretative skills and authentic writing, areas where AI may be perceived as less essential (Asunda et al. 2023; Wang et al. 2024). University assessments further reinforce these differences: humanities courses often emphasize critical argumentation, originality, and essay-based evaluations, where AI may be less helpful or even misaligned with learning goals due to its limited capacity for nuanced reasoning and deep interpretive understanding (Revell et al. 2024; Karkoulian et al. 2024). In contrast, STEM assessments frequently involve structured problem-solving or programming tasks, which students find more compatible with AI support (Asunda et al. 2023; Wang et al. 2024). Language also plays a role, as many humanities programs in Jordan are taught in Arabic, while science and health programs are predominantly in English, making AI tools optimized for English more accessible to the latter group (Kalyan 2023).

Despite this high engagement, only 57.5% of students considered themselves moderately to very knowledgeable about AI. This suggests that many students use AI without fully understanding its mechanisms or limitations, raising concerns about superficial engagement, over-reliance, and potential misuse, and highlighting the need for critical AI literacy and responsible usage (Akgun and Greenhow 2022; UNESCO 2021).

Table 5 Linear regression analyses to predict knowledge and awareness of AI use in education utilizing the demographic variables among the study sample ($n = 885$)

Dependent variable	Predictors*	Unstand Co		Stand Co	T	P	95% CI for B	
		B	SE	Beta			Lower Bound	Upper Bound
Total Knowledge total score ($R^2 = 0.035$)	Constant	18.177	2.489	—	7.303	< 0.001	13.292	23.063
	Age	0.244	0.096	0.088	2.553	0.011	0.056	0.432
	Gender	1.225	0.574	0.071	2.134	0.033	0.098	2.352
	School category	2.337	0.437	0.178	5.354	< 0.001	1.480	3.194
General awareness section score ($R^2 = 0.023$)	Constant	6.852	1.089	—	6.291	< 0.001	4.714	8.990
	School category	0.924	0.191	0.162	4.839	< 0.001	0.549	1.299
Ethical awareness section total score ($R^2 = 0.046$)	Constant	8.149	1.829	—	4.456	< 0.001	4.560	11.738
	Age	0.222	0.070	0.109	3.151	0.002	0.084	0.360
	Gender	1.330	0.422	0.105	3.153	0.002	0.502	2.157
	School category	1.662	0.321	0.172	5.182	< 0.001	1.033	2.291
Institution support section total score ($R^2 = 0.032$)	Constant	2.618	0.334	—	7.842	< 0.001	1.963	3.274
	Age	−0.034	0.013	−0.091	−2.627	0.009	−0.059	−0.009
	Academic degree	0.332	0.100	0.115	3.314	0.001	0.135	0.529
	School category	−0.223	0.059	−0.127	−3.813	< 0.001	−0.338	−0.108
Training section total score ($R^2 = 0.012$)	Constant	0.558	0.170	—	3.277	0.001	0.224	0.892
	Age	0.020	0.007	0.107	3.045	0.002	0.007	0.033
Item 2.1. Knowledge level of AI use in academic field ($R^2 = 0.020$)	Constant	2.426	0.287	—	8.439	< 0.001	1.862	2.990
	Gender	−0.233	0.066	−0.118	−3.509	< 0.001	−0.363	−0.103
Item 2.4. Frequency of using AI in academic field ($R^2 = 0.013$)	Constant	1.845	0.353	—	5.233	< 0.001	1.153	2.538
	School category	0.174	0.062	0.095	2.813	0.005	0.053	0.295
Item 3.2. Knowledge of the ethical uses of AI by students total score ($R^2 = 0.054$)	Constant	1.361	0.590	—	2.307	0.021	0.203	2.519
	School category	0.704	0.103	0.225	6.808	< 0.001	0.501	0.907
Item 3.7. Knowledge of the measures to ensure ethical AI use by students total score ($R^2 = 0.040$)	Constant	0.492	0.679	—	0.725	0.469	−0.841	1.824
	Age	0.066	0.026	0.088	2.531	0.012	0.015	0.117
	Gender	0.480	0.157	0.102	3.064	0.002	0.172	0.787
	School category	0.576	0.119	0.161	4.837	< 0.001	0.342	0.810
Item 4.1. Familiarity with current ethical guidelines for AI use in academia ($R^2 = 0.018$)	Constant	2.241	0.331	—	6.764	< 0.001	1.591	2.891
	Academic degree	0.204	0.099	0.072	2.056	0.040	0.009	0.399
	School category	−0.188	0.058	−0.109	−3.234	0.001	−0.302	−0.074
Item 4.2. Knowledge of the principles of ethical AI use in education total score ($R^2 = 0.019$)	Constant	−0.777	0.910	—	−0.854	0.394	−2.564	1.010
	Age	0.094	0.035	0.094	2.682	0.007	0.025	0.163
	Gender	0.566	0.210	0.091	2.696	0.007	0.154	0.978
	School category	0.361	0.160	0.076	2.264	0.024	0.048	0.675

R^2 = Coefficient of determination, Unstand Co = Unstandardized coefficient, Stand Co = Standardized coefficient, B = Beta statistics, SE = Standard Error, t = t statistics, p = Two tailed probability value, CI = Confidence intervals. *Gender, age, academic degree, and major school categories were entered in the regression model, and the significant predictors are only presented in the table

Ethical use of AI language models

Despite the high rate of AI usage, the study revealed a moderate level of concern about the ethical implications of AI in education (35%). Ethical concerns were more pronounced among students in health sciences compared to those in humanities, likely reflecting the unique dilemmas in fields where AI could directly impact patient care and medical decision-making or the increasing awareness of potential risks (Lysaght et al. 2019; Haltaufderheide and Ranisch 2024). However, when ethical knowledge was

Table 6 Logistic regression analyses to predict whether participants used AI before, observed unethical use of AI, and interested in receiving training on ethical AI use in education utilizing the demographic variables among the study sample ($n = 885$)

Dependent variable	Predictors*	B	SE	Df	P	Odds ratio	Odds ratio 95% CI	
							Lower	Upper
Item 2.3. Used AI in university before POP = 78.3% $NR^2 = 0.029$ HL = 0.283	Constant	2.058	0.617	1	0.001	7.831	—	—
	Humanities schools[$]	−0.643	0.261	1	0.014	0.526	0.315	0.877
Item 3.4. Observed unethical AI use by students before POP = 60.2% $NR^2 = 0.019$ HL = 0.219	Constant	0.109	0.556	1	0.845	1.115	—	—
	Gender	−0.299	0.144	1	0.038	0.741	0.559	0.983
	Humanities schools[$]	−0.522	0.220	1	0.018	0.593	0.386	0.913
Item 6.1. Interested in training for ethical AI use POP = 76.7% $NR^2 = 0.024$ HL = 0.442	Constant	−1.021	0.861	1	0.236	0.360	—	—
	Age	0.094	0.040	1	0.018	1.098	1.016	1.188
	Humanities schools[$]	0.549	0.250	1	0.028	1.732	1.061	2.828

POP = Predicted overall percentage in the final block, NR^2 = Nagelkerke coefficient of determination for the final block, HL = Hosmer and Lemeshow test probability value for the final block, B = the B coefficient of the model, SE = Standard error of B coefficient, df = Degree of freedom, p = Two-tailed probability value, 95%CI = 95% Confidence intervals. [$] = Reference category is Schools of science and engineering. *Gender, age, academic degree, and major school categories were entered in the regression model, and the significant predictors are only presented in the table

Table 7 Linear regression analyses to predict knowledge and awareness of ethical use of AI in education utilizing the demographic variables and the general awareness and usage of AI section and item scores among the study sample ($n = 885$)

Dependent variable	Predictors*	Unst Co		St Co	T	P	95% CI for B	
		B	SE	Beta			Lower Bound	Upper Bound
Item 3.1. Have ethical concerns regarding students use of AI in education ($R^2 = 0.007$)	Constant	1.794	0.323	—	5.559	< 0.001	1.160	2.427
	Item 2.1. Level of overall knowledge in AI use in education	0.089	0.045	0.084	1.963	0.050	0.000	0.179
Item 4.1. Familiarity with current ethical guidelines for AI use in academia ($R^2 = 0.082$)	Constant	1.523	0.336	—	4.528	< 0.001	0.863	2.184
	School category	−0.191	0.058	−0.111	−3.326	0.001	−0.304	−0.078
	Item 2.1. Level of overall knowledge in AI use in education	0.278	0.047	0.242	5.863	< 0.001	0.185	0.371
Ethical awareness section score ($R^2 = 0.208$)	Constant	5.579	1.750	—	3.187	0.001	2.143	9.014
	Age	0.191	0.065	0.094	2.955	0.003	0.064	0.318
	Gender	1.122	0.391	0.088	2.871	0.004	0.355	1.889
	School category	0.892	0.299	0.092	2.981	0.003	0.305	1.479
	Item 2.1. Level of overall knowledge in AI use in education	−1.023	0.247	−0.159	−4.146	< 0.001	−1.508	−0.539
	Item 2.4. Frequency of using AI in academic field	−0.963	0.249	−0.183	−3.862	< 0.001	−1.453	−0.474
	General awareness of AI use section score	1.069	0.097	0.631	11.077	< 0.001	0.880	1.259

R^2 = Coefficient of determination, Unst Co = Unstandardized coefficient, St Co = Standardized coefficient, B = Beta statistics, SE = Standard Error, t = t statistics, p = Two tailed probability value, CI = Confidence intervals. *Gender, age, academic degree, major school categories, level of overall knowledge in AI use (item 2.1), used AI in university studying before (item 2.3), frequency of using AI in academic field (item 2.4), and general awareness of AI use section score were entered in the regression model, and the significant predictors are only presented in the table

assessed, health sciences students were the least aware of AI-related ethical principles ($p < 0.001$, Table 2), highlighting a gap between recognizing ethical challenges and being prepared to address them (Migdadi et al. 2024).

Most students considered AI use for translation, proofreading, literature reviews, data analysis, and exam preparation ethically acceptable. Yet, 39.8% reported witnessing unethical use, mainly cheating or over-reliance. Reports were highest in science and engineering, reflecting frequent AI use in technical coursework, which increases both opportunities and risks for misuse (Ihekweazu et al. 2023; Oravec 2023; Kalyan 2023).

Several international studies show that cultural and institutional contexts can influence students' ethical perceptions and use of AI. One Australian study found that over a third of students had used AI chatbots to help with assessments and did not see this as a breach of academic integrity (Gruenhagen et al. 2024). In the US and Hong Kong, students recognized the usefulness of AI for learning, writing, and research, but they expressed concerns about accuracy, privacy, and the impact on careers (Stritto et al. 2024; Chan and Hu 2023). A study in the UK reported that students use AI daily for study and personal tasks, and they want practical support, clear guidance, and training to use AI responsibly and fairly (Attewell 2025). Research in Turkey identified different groups of AI users: some with high adoption but low ethical concern, others with moderate adoption and high ethical awareness, highlighting the influence of age, discipline, and gender on AI use and ethical perceptions (Adalı and Bilgili 2025).

In Jordan, our study showed high levels of AI use, with 39.8% of students reporting witnessing unethical use. Despite this engagement, awareness of AI-related ethical guidelines remained limited. These findings emphasize the need for clear policies, context-sensitive training, and guidance for both students and faculty to promote responsible AI use, consistent with concerns identified in our previous study with academic staff (Alnsour et al. 2025b).

Our study also found a positive correlation between AI use, knowledge, and ethical awareness. Students who used AI more frequently and had greater knowledge were more likely to recognize its ethical implications. Older students and those in advanced programs (e.g., PhD) demonstrated higher AI knowledge and ethical awareness, with each additional year of age increasing knowledge and ethical awareness scores by 0.24 and 0.22, respectively (Table 5). These results align with international findings that greater exposure and academic experience enhance both familiarity and ethical reflection (Deng et al. 2025; Migdadi et al. 2024). Frequent AI users also showed stronger ethical reflection, supporting evidence that engagement promotes responsible use (Wang et al. 2025). Overall, regular AI engagement combined with advanced academic exposure fosters both knowledge and ethical awareness, emphasizing the importance of structured education and guidance for responsible AI use.

Institutional support and future training needs

The study revealed gaps in institutional support for ethical AI use, many students reported inadequate guidance despite strong interest in training, highlighting the need for structured policies and targeted interventions. Similar patterns have been observed internationally (Attewell 2025; Smit et al. 2025). Humanities students expressed the strongest interest in training, likely due to limited exposure in their curricula and concerns about maintaining originality in assignments requiring independent thought

(Wang et al. 2024). However, they were also the least frequent users and least knowledgeable, suggesting that training must account for disciplinary differences, language barriers, and concerns about academic repercussions.

Practical approaches for training and policy development may include: (a) Structured online modules embedded in the learning management system and required before each academic year, ensuring all students have a consistent foundation in ethical AI use; (b) Discipline-specific integration, such as clinical decision-making and patient privacy for health sciences, research integrity and data handling for sciences, and originality and authorship for humanities; (c) Annual workshops and interactive case discussions for students and faculty, demonstrating acceptable AI applications (e.g., brainstorming, data analysis, language support) followed by reflection on ethical dilemmas; and (d) Establishing a dedicated AI ethics body at the university to provide ongoing guidance, monitor emerging challenges, and host regular faculty-student meetings. Together, these measures can normalize responsible AI use, reduce fears of misuse, and foster confidence across disciplines, while addressing gaps in both student and faculty competencies. (Alnsour et al. 2025b)

Conclusion

This study highlights the increasing role of AI in university education and reveals notable differences in its use and ethical awareness among Jordanian students, influenced by factors such as gender, field of study, and prior AI exposure. The findings underscore the urgent need for universities to implement clear, discipline-specific ethical guidelines, offer structured professional development, and foster collaborative initiatives such as workshops and discussion panels involving both students and academic staff to promote the responsible and ethical integration of AI in higher education.

Strengths, limitations, and future directions

This study has several strengths. It included a relatively large and diverse sample of 885 university students from multiple universities across Jordan, providing valuable insights into students' knowledge, usage, and perceptions of AI, though this represents only a small fraction of the national student population. The survey instrument was carefully designed, validated by academic experts, and pilot-tested to ensure clarity, relevance, and reliability. Comprehensive statistical analyses, including regression models, were employed to examine associations between demographics, AI knowledge, ethical awareness, and institutional support.

Several limitations should be acknowledged. First, the study relied on self-reported data, which may be subject to social desirability or recall bias. Second, the electronic distribution method may have favored students with higher engagement in online platforms, potentially limiting generalizability. Third, the cross-sectional design precludes establishing causal relationships between AI use, knowledge, and ethical awareness.

Future research could employ longitudinal designs to track changes in students' AI knowledge and ethical awareness over time. Qualitative studies could explore student perspectives more deeply, providing richer insights into motivations and challenges associated with AI use. Additionally, collaborative initiatives, such as workshops or discussion panels, could be evaluated to determine their effectiveness in enhancing ethical

AI understanding both within Jordanian universities and in comparable higher education contexts internationally.

Abbreviations

AI	Artificial Intelligence
NLG	Natural Language Generation
UNESCO	United Nations Educational, Scientific and Cultural Organization
IRB	Institutional Review Board
OECD	Organization for Economic Co-operation and Development
STEM	Science, Technology, Engineering, and Mathematics

Supplementary information

The online version contains supplementary material available at https://doi.org/10.1007/s40979-025-00206-6.

Supplementary material 1

Author contributions

M.M.A. contributed to conceptualization and led the writing of the original draft. M.M.A. and H.A. developed the study methodology. H.A. and M.K.A. conducted the formal analysis. M.M.A., L.Q., H.A., R.A.A., and M.Q.M.M. contributed to data curation. M.M.A., H.A., L.Q., R.A.A., M.Q.M.M., and M.K.A. contributed to reviewing and editing the manuscript.

Funding

No funding was received for this study.

Data availability

To help preserve the anonymity of students the survey responses are not included in an open-access repository. The data may be provided upon request to the authors and approval of the university research ethics board.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board (IRB) at the University of Jordan (Reference: 247/2024). Informed consent was obtained online, and participation in the survey was voluntary. Consent was implied through participant's completion of the survey, as approved by the IRB.

Consent for publication

Participants consented to the publication of anonymized data and findings derived from the study.

Competing interests

The authors declare no competing interests.

Received: 19 June 2025 / Accepted: 18 October 2025

Published online: 13 November 2025

References

Adalı GK, Bilgili A (2025) Generative AI in higher education: students' perspectives on adoption, ethical concerns, and academic impact. Acta Infologica 9(1):147–166

Akgun S, Greenhow C (2022) Artificial intelligence in education: addressing ethical challenges in K-12 settings. AI Ethics 2(3):431–440

Alnsour MM, Qouzah L, Aljamani S, Alamoush RA, Al-Omiri MK (2025a) AI in education: enhancing learning potential and addressing ethical considerations among academic staff-a cross-sectional study at the University of Jordan. IJEI 21(1):1–26

Alnsour MM, Alenezi R, Barakat M, Al-Omiri MK (2025b) Assessing ChatGPT's suitability in responding to the public's inquires on the effects of smoking on oral health. BMC Oral Health 25(1):1207. https://doi.org/10.1186/s12903-025-06377-5

Asunda P, Faezipour M, Tolemy J, Engel MT (2023) Embracing computational thinking as an impetus for artificial intelligence in integrated stem disciplines through engineering and technology education. J Technol Educ 34(2):43–63

Attewell S (2025) Student perceptions of AI 2025. Jisc. Retrieved from: https://www.jisc.ac.uk/reports/student-perceptions-of-ai-2025

Baidoo-Anu D, Ansah LO (2023) Education in the era of generative artificial intelligence (AI): understanding the potential benefits of ChatGPT in promoting teaching and learning. J AI 7(1):52–62

Chan CKY, Hu W (2023) Students' voices on generative AI: perceptions, benefits, and challenges in higher education. Int J Educ Technol Higher Educ 20(1):43

Deng N, Liu EJ, Zhai X (2025 July) Understanding university students' use of generative AI: the roles of demographics and personality traits. In: International Conference on Artificial Intelligence in Education, Springer Nature Switzerland, Cham, pp 281–293

European Commission (2019) Ethics guidelines for trustworthy AI. Publications Office of the European Union. Retrieved from https://ec.europa.eu/futurium/en/ai-alliance-consultation/guidelines

Gottschalk F, Weise C (2023) Digital equity and inclusion in education: an overview of practice and policy in OECD countries. OECD. https://one.oecd.org/document/EDU/WKP(2023)14/en/pdf

Gruenhagen JH, Sinclair PM, Carroll JA, Baker PR, Wilson A, Demant D (2024) The rapid rise of generative AI and its implications for academic integrity: students' perceptions and use of chatbots for assistance with assessments. Comput Educ Artif Intel 7:100273
Hajkowicz S, Sanderson C, Karimi S, Bratanova A, Naughtin C (2023) Artificial intelligence adoption in the physical sciences, natural sciences, life sciences, social sciences and the arts and humanities: a bibliometric analysis of research publications from 1960-2021. Technol Soc 74:102260
Halaweh M (2023) ChatGPT in education: strategies for responsible implementation. Contemp Educ Technol 15(2)
Haltaufderheide J, Ranisch R (2024) The ethics of ChatGPT in medicine and healthcare: a systematic review on large language models (LLMs). NPJ Digit Med 7(1):183
Holmes W, Porayska-Pomsta K, Holstein K, Sutherland E, Baker T, Shum SB, Santos OC, Rodrigo MT, Cukurova M, Bittencourt II, Koedinger KR (2022) Ethics of AI in education: towards a community-wide framework. Int J Artif Intel Educ 1–23https://www.oecd.org/en/publications/2023/04/ai-language-models_46d9d9b4.html
Huang M-H, Rust RT (2018) Artificial intelligence in service. J Service Res 21(2):155–172. https://doi.org/10.1177/1094670517752459
Ihekweazu C, Zhou B, Adelowo EA (2023) The use of artificial intelligence in academic dishonesty: ethical considerations. In: Proceedings of the ISCAP Conference, vol 2473. pp 4901
Jordan Ministry of Digital Economy and Entrepreneurship (2022) Jordan's artificial intelligence strategy and implementation plan 2023-2027. Retrieved from https://www.modee.gov.jo/ebv4.0/rootstorage/en/eblistpage/40435648.pdf
Kalyan KS (2023 Dec 19) A survey of GPT-3 family large language models including ChatGPT and GPT-4. Nat Lang Process J 100048
Karkoulian S, Sayegh N, Sayegh N (2024) ChatGPT unveiled: understanding perceptions of academic integrity in higher education-a qualitative approach. J Acad Ethics 23(4):1171–1188
Kasneci E, Seßler K, Küchemann S, Bannert M, Dementieva D, Fischer F, Gasser U, Groh G, Günnemann S, Hüllermeier E, Krusche S (2023) ChatGPT for good? On opportunities and challenges of large language models for education. Learn Individ Differ 103:102274
Linkon AA, Shaima M, Sarker MSU, Badruddowza, Nabi N, Rana MNU et al (2024) Advancements and applications of generative artificial intelligence and large language models on business management: a comprehensive review. J Comput Sci Technol Studies 6:225–232. https://doi.org/10.32996/jcsts.2024.6.1.26
Liu R, Rizzo S, Whipple S, Pal N, Pineda AL, Lu M, Arnieri B, Lu Y, Capra W, Copping R, Zou J (2021) Evaluating eligibility criteria of oncology trials using real-world data and AI. Nature 592(7855):629–633
Lysaght T, Lim HY, Xafis V, Ngiam KY (2019) AI-assisted decision-making in healthcare: the application of an ethics framework for big data in health and research. Asian Bioeth Rev 11:299–314
Mhlanga D (2023) Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning. SSRN Electron J. https://doi.org/10.2139/ssrn.4354422
Migdadi MK, Oweidat IA, Alosta MR, Al-Mugheed K, Saeed Alabdullah AA, Farghaly Abdelaliem SM (2024) The association of artificial intelligence ethical awareness, attitudes, anxiety, and intention-to-use artificial intelligence technology among nursing students. Digit Health 10. https://doi.org/10.1177/20552076241301958
Mizumoto A, Eguchi M (2023) Exploring the potential of using an AI language model for automated essay scoring. Res Methods Appl Linguistics 2(2):100050
Monasterio Astobiza A, Ausín T, Liedo B, Toboso M, Aparicio M, López D (2022 April) Ethical governance of AI in the global south: a human rights approach to responsible use of AI. In Proceedings 81(1):136. MDPI
Nguyen QT (2023) Artificial intelligence (AI) in education: a case study on ChatGPT's influence on student learning behaviors
OECD (2023) AI and language models. https://www.oecd.org/en/publications/2023/04/ai-language-models_46d9d9b4.html
Oravec JA (2023) Artificial intelligence implications for academic cheating: expanding the dimensions of responsible human-AI collaboration with ChatGPT. J Interact Learn Res 34:213–237
Pedro F, Subosa M, Rivas A, Valverde P (2019) Artificial intelligence in education: challenges and opportunities for sustainable development. https://unesdoc.unesco.org/ark:/48223/pf0000366994
Revell T, Yeadon W, Cahilly-Bretzin G, Clarke I, Manning G, Jones J, … Leneghan F (2024) ChatGPT versus human essayists: an exploration of the impact of artificial intelligence for authorship and academic integrity in the humanities. IJEI 20(1):18
Smit M, Wagner RF, Bond-Barnard TJ (2025) Ambiguous regulations for dealing with AI in higher education can lead to moral hazards among students. Project Leadersh Soc 100187
Sok S, Heng K (2023) ChatGPT for education and research: a review of benefits and risks. Cambodian J Edu Res 3(1):110–121
Stöhr C, Ou AW, Malmström H (2024) Perceptions and usage of AI chatbots among students in higher education across genders, academic levels and fields of study. Comput Educ Artif Intel 7:100259. https://doi.org/10.1016/j.caeai.2024.100259
Stritto MED, Underhill GR, Aguiar NR (2024) Online students' perceptions of generative AI
UNESCO (2021) Recommendation on the ethics of artificial intelligence. United Nations Educational, Scientific and Cultural Organization. Retrieved from https://www.ohchr.org/sites/files/2022-03/UNESCO.pdf
Wang C, Aguilar SJ, Bankard JS, Bui E, Nye B (2024) Writing with AI: what college students learned from utilizing ChatGPT for a writing assignment. Educ Sci 14(9):976
Wang Z, Chai CS, Li J, Lee VWY (2025) Assessment of AI ethical reflection: the development and validation of the AI ethical reflection scale (AIERS) for university students. Int J Educ Technol Higher Educ 22(1):19

Publisher's Note