

Article

University Students' Usage of Generative Artificial Intelligence for Sustainability: A Cross-Sectional Survey from China

Lin Xiao ^{1,2}, How Shwu Pyng ^{1,*} , Ahmad Fauzi Mohd Ayub ¹ , Zhihui Zhu ^{1,2,*}, Jianping Gao ¹ and Zehu Qing ²

¹ Faculty of Educational Studies, Universiti Putra Malaysia, Serdang 43400, Malaysia; gs64351@student.upm.edu.my (L.X.); afmy@upm.edu.my (A.F.M.A.); gs61074@student.upm.edu.my (J.G.)
² Faculty of Teacher Education, Baise University, Baise 533000, China; linxuanlw@163.com
* Correspondence: shwu.pyng@upm.edu.my (H.S.P.); gs60543@student.upm.edu.my (Z.Z.)

Abstract: The rapid development of generative artificial intelligence (GenAI) technology has triggered extensive discussions about its potential applications in sustainable higher education. Based on the technology acceptance model (TAM) and task–technology fit (TTF) theory, this research aimed to investigate the current situations and challenges of Chinese university students using GenAI in four typical task scenarios. This was performed using a cross-sectional research design. The data were collected via questionnaire, with 486 undergraduates from a Chinese university participating. The data analysis methods include descriptive statistics, inferential statistics, and content analysis. The results show that more than 70% of university students actively use GenAI, but nearly half of them are not very proficient in its use. Doubao and ERNIE Bot are the GenAI tools they prefer most. The primary functions they use are text production and information retrieval. They mainly learn the relevant knowledge and skills through self-media and knowledge-sharing platforms. Among the four typical task scenarios, GenAI is widely used in course learning and research activities, while its application in daily life and job search is relatively limited. The analysis of demographic variables shows that grade and major have a significant impact on university students' use of GenAI. In addition, university students suggest that universities should offer relevant courses or lectures and provide comprehensive technical support to improve the popularity and operability of GenAI. This study provides suggestions for universities, education administration departments, and technology development departments to improve GenAI services. It will help universities optimize the allocation of educational resources and promote educational equity for sustainability.

Keywords: generative artificial intelligence (GenAI); university students; usage status; sustainability; cross-sectional research



Academic Editor: Naser Sedghi

Received: 6 March 2025

Revised: 31 March 2025

Accepted: 10 April 2025

Published: 15 April 2025

Citation: Xiao, L.; Pyng, H.S.; Ayub, A.F.M.; Zhu, Z.; Gao, J.; Qing, Z.

University Students' Usage of Generative Artificial Intelligence for Sustainability: A Cross-Sectional Survey from China. *Sustainability* **2025**, *17*, 3541. <https://doi.org/10.3390/su17083541>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

In the 21st century, artificial intelligence (AI) is widely regarded as a pivotal factor driving technological revolution and industrial transformation. It has increasingly become a hot topic of research within the academic community. At present, the foremost technological advancement in the field is generative artificial intelligence (GenAI). GenAI is defined as a technology that generates text, pictures, sounds, videos, codes, and other outputs based on machine learning algorithms and generative models [1–3]. Unlike traditional AI, GenAI can create unique new data by learning the patterns of input data, rather than just processing and analyzing it [4]. The representative technologies that people are familiar with mainly include generative adversarial networks (GANs), transformer-based models (TRMs), variational autoencoders (VAEs), and diffusion models (DMs) [1].

Despite decades of research, GenAI has only recently attracted significant attention. GenAI originated between the 1950s and the 1980s [5]. It was mainly focused on the field of language generation, such as the chatbot ELIZA developed by MIT in the 1960s [6,7]. In 2014, Ian Goodfellow and colleagues introduced the generative adversarial network (GAN), signifying a significant advancement in GenAI [8]. It was not until 2020 that OpenAI released Generative Pre-trained Transformer 3 (GPT-3), which is a model capable of generating diverse texts with Internet data and is considered one of the largest language models ever [9]. At the end of 2022, OpenAI released GPT-3.5, and the number of users reached 1 million within five days, which further stimulated a wave of global research on AI and marked the entry of GenAI onto the stage of large-scale commercial applications [10].

Chinese researchers also attach immense importance to the development and application of GenAI technology. According to a survey by Statistical Analysis System Institute and Coleman Parkes Research, China has become a global leader in the application of GenAI [11]. According to the latest data, as of December 2024, about 331 million people in China said they had heard of GenAI products, of whom, 249 million had used them [12]. Simultaneously, researchers have developed GenAI tools like Doubao, KIMI, ERNIE Bot, and Deepseek, among others. They are widely used in image generation, video synthesis and generation, natural language processing, knowledge graph generation, interdisciplinary applications, and other fields.

GenAI may have a giant impact on the sustainable development of higher education. The fourth goal of the United Nations Sustainable Development Goal is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Many scholars recognize the potential opportunities that GenAI brings to achieving the Sustainable Development Goals for higher education [13].

First of all, GenAI has changed the traditional teaching methods, which will help provide better higher education and help university students better adapt to the development of future society. Studies have shown that the natural language processing function that GenAI is particularly adept at can meet the needs of university students in language learning, translation, and writing [14]. GenAI can help students conduct scientific research and improve the efficiency and quality of academic writing through big data analysis [15]. GenAI can also help students generate novel ideas and stimulate innovation [16]. GenAI has also shown unique advantages in learning assessment [17]. It can not only automatically generate and batch-modify homework and tests but also provide timely feedback [18]. Teachers can also identify teaching problems, change teaching methods, and adjust teaching strategies by analyzing students' learning data [19]. Secondly, GenAI promotes the realization of educational equity. It can provide efficient and customized learning materials based on students' learning styles, interests, and knowledge mastery levels and provide them with timely, individualized feedback [19]. It will help university students from different backgrounds to obtain high-quality education and narrow the gap in educational resources. Finally, GenAI helps optimize the use of educational resources. GenAI can help with classroom management, reducing the administrative burden on teachers by automating the management of course schedules, student attendance, homework assignments, and related tasks [20]. GenAI can also support environmental sustainability by outputting digital educational learning resources and reducing waste of paper materials [21].

However, the negative impact of GenAI on the sustainable development of higher education should not be ignored. GenAI raises multiple worries about academic ethics and academic integrity issues for the future [22]. Students may abuse GenAI tools to produce papers or assignments that do not reflect their efforts. In addition, GenAI-generated content may lack proper citations or contain false or misleading information, raising concerns about plagiarism and the integrity of academic achievements [23]. Therefore, some universities

have prohibited the use of ChatGPT. For example, public schools in New York and Seattle, the Paris Institute of Political Studies in France, and the University of Hong Kong have banned the use of ChatGPT and other AI tools [24]. Additional research indicates that GenAI may lead university students to be excessively dependent on tools, thus diminishing their critical thinking and creativity [25]. Furthermore, GenAI has caused doubts about the security of educational data [26]. Given that GenAI requires extensive educational data, it is very probable that it may lead to the leaking and misuse of students' sensitive information.

GenAI presents both opportunities and challenges for sustainable higher education. What is the perspective of university students—a significant demographic of GenAI users—on GenAI? This has attracted widespread attention from researchers around the world. So far, survey data from countries such as the United Kingdom, the United States, Portugal, Saudi Arabia, Jordan, Vietnam, the Philippines, Malaysia, Ghana, and China show that the majority of students have a positive attitude towards the application of GenAI in higher education and have a high degree of acceptance of the use of GenAI [14,27–35]. They believe that in the future, the application of GenAI in higher education will continue to expand. At the same time, university students also expressed concerns about GenAI. Misinformation, technology dependence, academic integrity, data security, and other issues are still hot topics of discussion [34,35]. However, most university students still maintain that despite the many problems associated with the use of GenAI in higher education, it will hinder educational progress in the future if GenAI is not recognized and effectively used in higher education [28]. These innovations should not be prohibited from entering colleges; rather, we should adopt an open attitude, accept, and use them. At the same time, university students also strongly advocate that GenAI technology should be integrated into university courses to better enhance technological literacy for the future [29].

A few academics have examined the use of GenAI among university students. Clare Baek investigated the perception and use of ChatGPT among 1001 university students in the United States. The results showed that gender, age, major, institution type, and institutional policy significantly affected the use of ChatGPT for general, writing, and programming tasks [36]. A study in Saudi Arabia showed that ChatGPT had become the most widely used GenAI tool, with students mainly using it to define or clarify concepts, translate, generate ideas in writing, and summarize academic literature. They highlighted advantages like easy access, time savings, and instant feedback. However, they expressed concerns about the challenges, including subscription fees, unreliable information, plagiarism, reduced human interaction, and impact on learning autonomy [4]. Qu et al. designed a questionnaire to assess the GenAI knowledge, usage intention, and engagement in GenAI cognition and daily tasks of students from Singapore. The results showed that there were significant disciplinary differences in the level of students' engagement in GenAI [37].

Chinese scholars have also paid attention to this research topic. A study from the Hong Kong University of Science and Technology investigated students' behaviors and experiences using ChatGPT. The results showed that ChatGPT services were widely used among students, with a significant inclination to persist in their usage. Students believe that ChatGPT has made a positive contribution to both their studies and career development. There are significant differences in students' experiences using ChatGPT based on gender, level of study, age group, discipline, and country of origin [38]. Li et al. randomly surveyed 1190 undergraduate students at Zhejiang University on their current usage of GenAI in four major scenarios: course learning, research activities, daily life, and further studies or job search. The results showed that ChatGPT is the GenAI tool that university students use the most. Text generation technology is the most popular technology used. Text generation and information search are the most popular GenAI functions. Scientific research is the

most common GenAI scenario. Gender, grade, and major category affect how university students use GenAI [39].

The analysis of the above literature reveals several research gaps in the existing literature, leading to the formation of new research questions.

Most of the current research focuses on university students' attitudes toward GenAI, and there is a lack of research on university students' actual experience of using GenAI. According to the technology acceptance model (TAM), perceived usefulness and perceived ease of use are two key factors that affect users' use of new technologies [40]. Perceived usefulness refers to the extent to which users believe that using a certain technology can improve their work, study, or life efficiency [41]. Perceived ease of use reflects the degree of effort that users believe is required to operate the technology [41]. In the context of the application of GenAI tools, perceived usefulness is reflected in university students' confidence in whether these tools can improve learning efficiency, while perceived ease of use is related to university students' familiarity when using these tools. Current research focuses on the investigation of perceived usefulness while ignoring the impact of perceived ease of use on university students' use of GenAI. Therefore, the first research question (RQ1) of this study is: what is the extent of GenAI-tool usage among university students in school?

Current research pays little attention to the impact of task requirements on university students' use of GenAI. The task–technology fit (TTF) theory holds that the effectiveness of technology is determined by the degree of match between task requirements and technical functions [42]. A higher degree of match means that the technology can effectively meet user needs, thereby improving its usage rate and task performance [42]. Task requirements determine the specific requirements for university students to complete various tasks, thereby affecting their use of GenAI. Technical functions reflect the ability of GenAI tools to support the corresponding academic tasks. However, there are few current studies that explore the use of the technical functions of GenAI tools by university students when facing different task requirements. Therefore, the second research question (RQ2) of this study is: what is the extent of GenAI tool usage among university students in different task scenarios, including course learning, research activities, daily life, and job search?

Regarding the research on university students' use of GenAI, there is very little data support from the cultural background of mainland China. Existing studies have indicated that there are significant differences in the use of GenAI by university students from different cultural backgrounds [4]. In terms of tools, ChatGPT is the most frequently used GenAI tool among university students in worldwide polls. Nonetheless, the outcome may vary in mainland China owing to regulation discrepancies, potentially resulting in significant variations in university students' use patterns and experiences with GenAI. In addition, the research population in China mostly consists of students from top universities [38,39]. They possess superior information resources and exhibit enhanced information literacy. Therefore, they do not accurately reflect the existing usage patterns of ordinary college students in China. The lack of attention paid to the general university population is detrimental to the formulation of sustainable higher education policies and the achievement of goals. Further research is needed to explore the differences and opinions of university students regarding the use of generative AI based on different demographic factors. Therefore, the third and fourth research questions (RQ3 and RQ4) of this study are:

RQ3: Is there a significant difference in the GenAI tools used among university students, based on three selected demographic factors (genders, grades, and majors)?

RQ4: What are the university students' recommendations for using GenAI tools?

Based on the above four research questions, the specific research objectives of this study are as follows:

1. To investigate the overall situation of university students using GenAI tools during their time at school.
2. To analyze the differences in university students' use of GenAI tools in different task scenarios.
3. To explore the impact of gender, grade and major on university students' use of GenAI tools.
4. To collect university students' opinions on the use of GenAI tools and suggestions for improvement.

2. Research Methodology

This study used a cross-sectional research design. The researchers conducted a questionnaire survey to investigate the current status of Chinese university students using GenAI.

2.1. Research Participants

The participants in this study are undergraduates from Baise University in the Guangxi Zhuang Autonomous Region, China. Baise University is a comprehensive university with 17 faculties and 57 majors. According to the characteristics of the disciplines, these majors are divided into four major categories: arts, science, engineering, and agriculture. In order to ensure that the research participants are widely representative, this study adopted a stratified cluster sampling method. First, the researchers conducted stratified sampling according to the majors and grades to ensure balanced coverage of each category. Then, within each category, the researchers conducted cluster sampling according to class to ensure a reasonable distribution of students in different grades. Finally, the researchers selected all university students in the sampled classes who met the survey criteria of this study as research participants. In total, the researchers included 726 university students from 18 classes as research participants.

2.2. Research Instrument

The research instrument adopted the Survey Questionnaire on the Current Status of GenAI Use among University Students compiled by Li et al. [39]. Then the researchers further refined and enhanced it in conjunction with the specific circumstances of Baise University students to more precisely represent the features of the target demographic. The revision work mainly involves the following aspects: Firstly, the GenAI tools commonly used by Chinese university students, such as Doubao and KIMI, were included. Secondly, some repetitive items were integrated, and the technologies and functions of GenAI used by university students were merged. Thirdly, some items were added. For example: What are the ways for university students to learn GenAI? Following the first assessment of the questionnaire, the researchers invited two experts in relevant fields to evaluate the scientificity and applicability of its content. Then, they further optimized the questionnaire's expression, logic, and item design based on the experts' suggestions to ensure reliability and validity. Subsequently, in order to test the practical applicability of the questionnaire, the researchers selected a class of 50 university students for a pilot survey. Based on the feedback, the researchers further optimized the questionnaire's expression, logical structure, and option settings to improve the reliability and validity of the questionnaire.

The updated questionnaire has four sections containing 27 questions. The Section 1 is basic information, including gender, grade, and major, totaling 3 items. The Section 2 is the basic situation of university students using GenAI, including familiarity, frequency of use, learning frequency, learning path, and tools and functions used, totaling 6 items. The Section 3 is about the use of GenAI by university students in four typical task scenarios, namely, course learning, research activities, daily life, and job search, with a total of 17 items.

The Section 4 is about university students' suggestions on the use of GenAI with one open-ended item.

2.3. Data Collection

This study collected data using the online questionnaire platform, "Wenjuanxing". To mitigate any bias in the data collection process, the researchers used neutral and non-leading words in the questionnaire design and provided detailed filling instructions when issuing the questionnaire, thus helping participants understand the questions accurately and give truthful answers. As of 12 January 2025, a total of 524 questionnaires were collected. To guarantee data quality, the researchers strictly screened the questionnaires and eliminated questionnaires with missing data, wrong answers, and repeated answers. Ultimately, the researchers obtained 486 valid questionnaires, achieving an effective rate of 92.75%. After the questionnaires were collected, the data were systematically coded and analyzed by SPSS 27.0. The basic demographic information of the participants is shown in Table 1.

Table 1. Basic demographic information of the participants ($n = 486$).

Characteristics	Attributes	Numbers	Percentages
Gender	Male	195	40.1%
	Female	291	59.9%
Grade	Freshman	106	21.8%
	Sophomore	150	30.9%
	Junior	126	25.9%
	Senior	104	21.4%
Major	Arts	175	36.0%
	Science	118	24.3%
	Engineering	110	22.6%
	Agriculture	83	17.1%
Total		486	100%

2.4. Data Analysis

The data collected and organized in this study are divided into two types of responses: quantitative and qualitative. Quantitative data were analyzed by descriptive and inferential statistics to comprehensively present the use of GenAI by university students. For RQ1 and RQ2, the researchers used descriptive statistical analysis to calculate means, standard deviations, frequencies, and percentages to outline university students' use of GenAI and the extent of their use in different task scenarios. For RQ3, the researchers used inferential statistical analysis, such as independent sample t-tests and one-way analysis of variance, to test significant differences in the use of GenAI based on different demographic characteristics (gender, grade, and major). For RQ4, the researchers used qualitative analysis methods to gain an in-depth understanding of university students' suggestions for the use of GenAI. Specifically, content analysis was used to identify and extract key themes to fully explore the opinions of the participants. According to the recommendations of Yilmaz, one researcher coded and categorized the qualitative data, and another researcher reviewed the coding categories to ensure accuracy [43]. The two researchers coded and categorized the suggestions for university students to use GenAI to extract core themes for in-depth analysis. According to the percentage absolute consistency rating method proposed by Miles and Huberman [44], the coding consistency was calculated to be 95%, indicating that the coding of the two researchers was highly consistent. For 5% of the disagreements, the researchers reached consensus through discussion and consultation.

2.5. Ethical Considerations

This study has obtained ethical approval from the Research Department of Baise University (approval number: 2013051). Before the start of the study, all participants were informed of the purpose of the study, data usage, and privacy protection measures and signed informed consent. Participants were informed that participation was voluntary, their responses would be strictly anonymous, and they had the right to withdraw from the study at any stage without any adverse effects.

3. Research Results

3.1. Overall Situation of University Students Using GenAI

This study investigated university students' familiarity with using GenAI (see Table 2). More than half (56.1%) of university students were familiar with GenAI; however, 34.2% of university students reported that they were not familiar with it, and 9.7% of university students even said they were totally unfamiliar with it.

Table 2. Familiarity of use of GenAI by university students.

Item	Option	Number	Percentage
Your familiarity with using GenAI.	1	47	9.7%
	2	166	34.2%
	3	208	42.8%
	4	58	11.9%
	5	7	1.4%

Note: 1 = very unfamiliar; 2 = unfamiliar; 3 = neutral; 4 = familiar; 5 = very familiar.

The researchers further investigated the frequency of use of GenAI by university students (see Table 3) and found that the vast majority (79.1%) of university students tend to actively use GenAI, a small number (19.1%) of university students rarely use it, and only a very small number (1.9%) of university students never use it.

Table 3. Frequency of use of GenAI by university students.

Item	Option	Number	Percentage
How often do you use GenAI?	1	9	1.9%
	2	93	19.1%
	3	254	52.3%
	4	119	24.5%
	5	11	2.3%

Note: 1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always.

What kinds of GenAI tools do university students use? The survey found (see Figure 1) that the most commonly used GenAI tools by university students are Doubao (78.2%) and ERNIE Bot (66.0%), followed by ChatGPT (36.2%), KIMI (22.2%), ChatGLM (18.1%), SparkDesk (16.5%), Notion AI (13.8%), and Dreamina (13.2%). A small number of university students use Gamma (9.9%) and others (7.6%), and some university students (2.5%) never use any GenAI tools.

What functions do university students prefer when using these GenAI tools? Through research, we found that the functions most used by university students are text generation (91.4%) and information search (81.5%), followed by image generation (42.4%) and language translation (30.0%), then video generation (24.9%), dialogue interaction (22.0%), voice generation (17.3%), and grammar checking (16.7%). A small number of university students use code generation (9.7%) and other functions (4.1%). Similarly, very few (2.5%) university students reported that they never used these functions (see Figure 2).

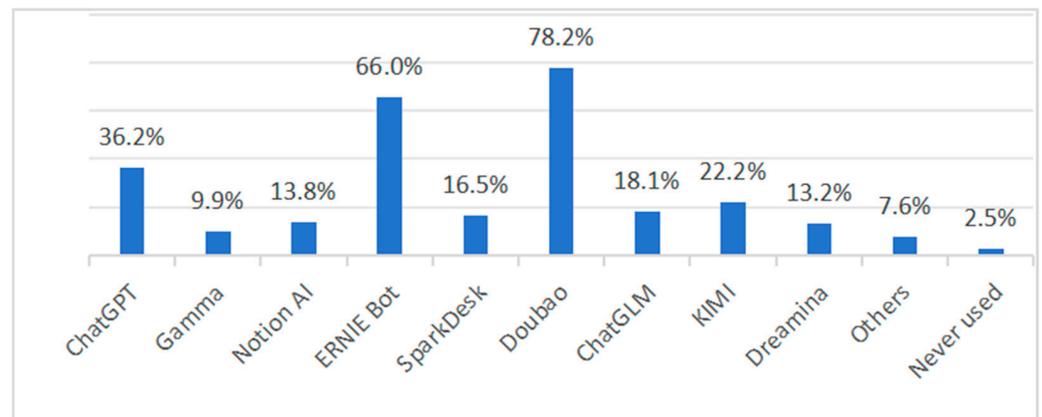


Figure 1. GenAI tools used by university students.

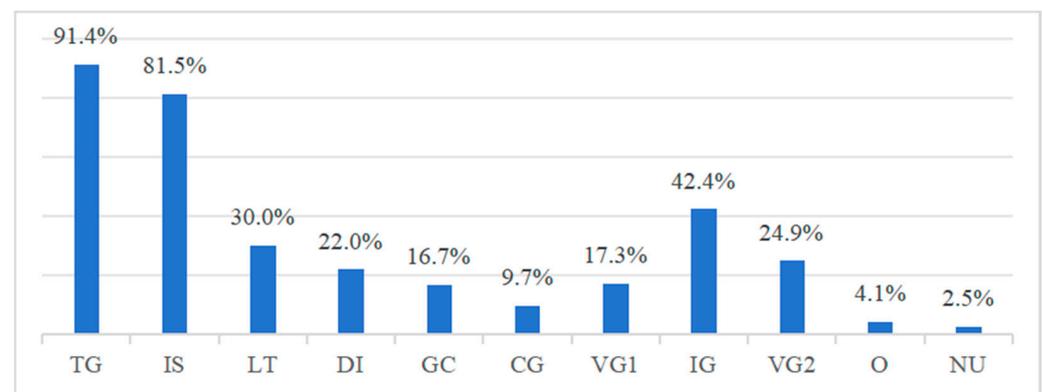


Figure 2. GenAI functions used by university students. Note: TG = text generation; IS = information search; LT = language translation; DI = dialogue interaction; GC = grammar checking; CG = code generation; VG1 = voice generation; IG = image generation; VG2 = video generation; O = others; NU = never used.

In addition, we also investigated the learning frequency (see Table 4) and learning ways (see Figure 3) of university students on GenAI. More than half (58.1%) of university students will actively learn how to use GenAI. However, 35.6% of university students rarely learn, and 6.2% of university students never learn.

Table 4. Frequency of GenAI learning among university students.

Item	Option	Number	Percentage
How often do you learn knowledge or skills used in GenAI?	1	30	6.2%
	2	173	35.6%
	3	215	44.2%
	4	60	12.3%
	5	8	1.6%

Note: 1 = never; 2 = rarely; 3 = sometimes; 4 = often; 5 = always.

Figure 3 shows that when it comes to learning how to use GenAI, the vast majority of university students will first choose self-media platforms (83.3%) and knowledge-sharing platforms (65.8%). Some university students will use developer communities or forums (22.6%) and online learning platforms (11.9%). In addition, some students will learn from courses or lectures (6.0%), academic papers (7.4%), and other channels (3.1%). In contrast, there are still a small number of university students who have never learned (5.6%) the use of GenAI technology.

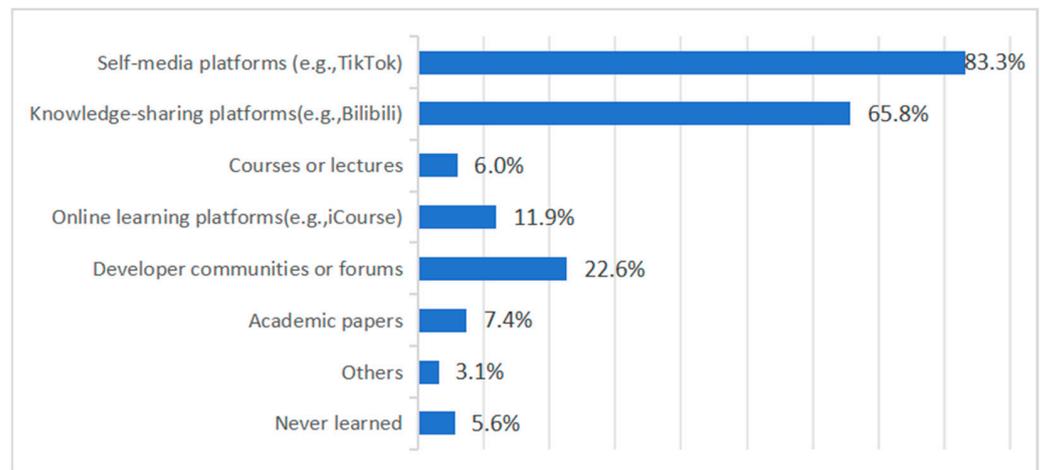


Figure 3. The ways for learning GenAI for university students.

3.2. Four Typical Task Scenarios of University Students Using GenAI

This study investigated the use of GenAI by university students in four typical scenarios: course learning, research activities, daily life, and job search (see Table 5). On average, course learning scored the highest ($M = 3.045$, $SD = 0.617$), followed by research activities ($M = 2.814$, $SD = 0.649$), daily life ($M = 2.390$, $SD = 0.744$), and job search ($M = 1.414$, $SD = 0.542$).

This study analyzed the number and proportion of university students who were “strongly consistent, consistent, and basically consistent” (hereinafter referred to as “consistent”) and “strongly inconsistent and inconsistent” (hereinafter referred to as “inconsistent”) through descriptive statistical analysis and found that the frequency of university students using GenAI in the four typical task scenarios was significantly different.

In terms of course learning, 87.9% of university students use GenAI to assist in completing course assignments, 85.4% of university students use GenAI to consult information related to the course content, and 76.3% of university students apply GenAI for evaluating their assignments and giving feedback, and 76.2% of university students use GenAI to answer teachers’ questions.

In terms of research activities, 78.8% of university students use GenAI to assist with writing and actively use GenAI to modify the text of papers or reports (69.8%), 67.1% of university students use GenAI to assist in selecting research questions, and 66.0% of university students use GenAI to translate foreign literature. In addition, 62.1% of university students use GenAI to extract key information from literature.

In daily life, 71.6% of university students use GenAI to ask questions about common sense, society, history, geography, culture, etc., 51.2% of university students will ask GenAI for help when they encounter difficulties (such as diet, financial management, and social interaction), 42.7% of university students will let GenAI design a variety of entertainment content to relax themselves; and 40.9% of university students will interact and chat with GenAI when they are bored. Only 30.8% of university students will let GenAI provide psychological counseling.

When it comes to job search, only a small number of university students use GenAI to recommend job information (9.5%), create or rewrite resumes (8.4%), and simulate interviews (3.5%).

Table 5. Descriptive statistics for four typical task scenarios of university students using GenAI.

Item	SI	I	BC	C	SC	Mean	SD
	n (%)	n (%)	n (%)	n (%)	n (%)		
Course Learning						3.045	0.617
1. You use GenAI to answer questions from teachers in class	13 (2.7)	103 (21.2)	304 (62.6)	61 (12.6)	5 (1.0)	2.881	0.687
2. You use GenAI to assist in completing course assignments	6 (1.2)	53 (10.9)	263 (54.1)	153 (31.5)	11 (2.3)	3.226	0.717
3. You use GenAI to check information related to course content	6 (1.2)	65 (13.4)	286 (58.8)	118 (24.3)	11 (2.3)	3.130	0.708
4. You let GenAI evaluate assignments and give feedback	11 (2.3)	104 (21.4)	277 (57.0)	90 (18.5)	4 (0.8)	2.942	0.721
Research activities						2.814	0.649
1. You use GenAI to assist in selecting research questions	12 (2.5)	148 (30.5)	252 (51.9)	72 (14.8)	2 (0.4)	2.802	0.728
2. You use GenAI to assist in writing	10 (2.1)	93 (19.1)	283 (58.2)	97 (20.0)	3 (0.6)	2.979	0.706
3. You use GenAI to revise papers or reports	24 (4.9)	123 (25.3)	255 (52.5)	81 (16.7)	3 (0.6)	2.827	0.783
4. You use GenAI to help extract key information from reading literature	43 (8.8)	141 (29.0)	234 (48.1)	64 (13.2)	4 (0.8)	2.681	0.842
5. You use GenAI to translate foreign academic articles or materials	32 (6.6)	129 (26.5)	247 (50.8)	71 (14.6)	7 (1.4)	2.778	0.827
Daily life						2.390	0.744
1. When you encounter difficulties in life (such as diet and financial management), you ask GenAI for help	89 (18.3)	148 (30.5)	191 (39.3)	52 (10.7)	6 (1.2)	2.461	0.951
2. You ask GenAI about common sense, society, history, geography, culture, and other issues	31 (6.4)	107 (22.0)	242 (49.8)	90 (18.5)	16 (3.3)	2.903	0.886
3. When you are bored, you chat with GenAI	115 (23.7)	172 (35.4)	153 (31.5)	41 (8.4)	5 (1.0)	2.278	0.952
4. You ask GenAI to design a variety of entertainment content (such as guessing puzzles, games, etc.) to relax yourself	116 (23.9)	163 (33.5)	169 (34.8)	28 (5.8)	10 (2.1)	2.286	0.960
5. You ask GenAI to provide psychological counseling	171 (35.2)	165 (34.0)	123 (25.3)	23 (4.7)	4 (0.8)	2.021	0.933
Job Search						1.414	0.542
1. You use GenAI to recommend job information	300 (61.7)	140 (28.8)	44 (9.1)	2 (0.4)	0 (0.0)	1.481	0.676
2. You let GenAI help you create or rewrite your resume	319 (65.6)	126 (25.9)	35 (7.2)	6 (1.2)	0 (0.0)	1.440	0.682
3. You interact with GenAI to simulate interviews	343 (70.6)	126 (25.9)	14 (2.9)	3 (0.6)	0 (0.0)	1.335	0.564

Note: SI = strongly inconsistent, I = inconsistent, BC = basically consistent, C = consistent, SC = strongly consistent.

3.3. Differences in the Use of GenAI by University Students

3.3.1. Gender Differences in University Students' Use of GenAI

This study used an independent sample t-test to analyze the means in the use of GenAI by university students of different genders (see Table 6). The results showed that although males used GenAI slightly more than females in course learning, research activities, daily life, and job search, there was no significant difference between them ($p > 0.05$).

Table 6. Gender differences in university students' use of GenAI.

	Male (<i>n</i> = 195) M ± SD	Female (<i>n</i> = 291) M ± SD	t	<i>p</i>
Course learning	3.062 ± 0.741	3.034 ± 0.518	0.458	0.647
Research activities	2.845 ± 0.738	2.792 ± 0.582	0.838	0.403
Daily life	2.425 ± 0.803	2.366 ± 0.701	0.847	0.397
Job search	1.421 ± 0.556	1.409 ± 0.534	0.231	0.818

3.3.2. Grade Differences in the Use of GenAI by University Students

Using one-way ANOVA, we compared the mean values of GenAI use among university students of different grades, and the results are shown in Table 7. There are significant differences between the university students of different grades in the fields of course learning ($F = 10.609, p < 0.001$), research activities ($F = 14.130, p < 0.001$), and job search ($F = 4.969, p = 0.002$). However, there are no significant differences in the field of daily life ($F = 1.272, p = 0.283$). Post hoc tests found that in terms of course learning, research activities, and job search, freshmen and sophomores were significantly lower than juniors and seniors. In addition, in terms of research activities, freshmen were significantly lower than sophomores.

Table 7. Grade differences in the use of GenAI by university students.

	Freshman (<i>n</i> = 106) M ± SD	Sophomore (<i>n</i> = 150) M ± SD	Junior (<i>n</i> = 126) M ± SD	Senior (<i>n</i> = 104) M ± SD	F	<i>p</i>
Course learning	2.835 ± 0.537	2.958 ± 0.638	3.228 ± 0.667	3.161 ± 0.508	10.609	<0.001 ***
Research activities	2.555 ± 0.601	2.720 ± 0.644	2.948 ± 0.630	3.050 ± 0.609	14.130	<0.001 ***
Daily life	2.298 ± 0.676	2.361 ± 0.695	2.421 ± 0.850	2.487 ± 0.736	1.272	0.283
Job search	1.299 ± 0.409	1.349 ± 0.487	1.484 ± 0.596	1.538 ± 0.631	4.969	0.002 **

Note: ** $p < 0.01$, *** $p < 0.001$.

3.3.3. Major Differences in the Use of GenAI by University Students

Using one-way ANOVA, we analyzed the mean values for the use of GenAI by university students of different majors (see Table 8). The study found that there were significant differences between university students of different majors in course learning ($F = 7.625, p < 0.001$) and research activities ($F = 5.843, p < 0.001$). However, in terms of daily life ($F = 0.910, p = 0.436$) and job search ($F = 2.259, p = 0.081$), the differences between them did not reach a significant level. After post hoc testing, it was found that in terms of course learning and research activities, the frequency of using GenAI by university students majoring in arts was significantly higher than that of students of engineering, science, and agriculture.

Table 8. Major differences in the use of GenAI by university students.

	Arts (<i>n</i> = 175) M ± SD	Science (<i>n</i> = 118) M ± SD	Engineering (<i>n</i> = 110) M ± SD	Agriculture (<i>n</i> = 83) M ± SD	F	<i>p</i>
Course learning	3.217 ± 0.581	2.934 ± 0.659	2.984 ± 0.579	2.919 ± 0.606	7.625	<0.001 ***
Research activities	2.971 ± 0.639	2.707 ± 0.663	2.769 ± 0.639	2.692 ± 0.604	5.843	<0.001 ***
Daily life	2.459 ± 0.766	2.354 ± 0.748	2.375 ± 0.735	2.313 ± 0.701	0.910	0.436
Job search	1.450 ± 0.589	1.483 ± 0.533	1.358 ± 0.522	1.313 ± 0.458	2.259	0.081

Note: *** $p < 0.001$.

3.4. University Students' Suggestions for Using GenAI

Two researchers simultaneously screened university students' suggestions for using GenAI and found that a total of 335 university students gave effective suggestions (see Table 9). The researchers coded and classified these suggestions and found that the most common suggestion from university students was to set courses or lectures on GenAI. They hoped to systematically learn the skills of GenAI. The second was to avoid the abuse of GenAI tools, improve the accuracy of GenAI, avoid plagiarism and academic misconduct, enhance the anthropomorphism of GenAI, and reduce its mechanical nature. The third was to promote the use of GenAI, focus on improving thinking skills, identify output content, provide channels for use, develop diverse functions, and reduce the homogeneity of generated content. A few university students also mentioned the need to issue guidelines for GenAI, conduct GenAI competitions or activities, and pay attention to data security and privacy.

Table 9. University students' suggestions on using GenAI ($n = 335$).

Coding Dimension	<i>n</i>	Example
Offer courses or lectures on GenAI	62	Offering a GenAI elective course, students can systematically learn how to use GenAI.
Avoid the abuse of GenAI tools	48	GenAI is only an auxiliary tool for learning, and it cannot be overly relied on to complete all learning tasks.
Improve the accuracy of GenAI	42	Integrate more professional databases to enhance the accuracy and reliability of the content generated by GenAI.
Avoid plagiarism, academic misconduct, etc.	39	Develop a GenAI detection system to help identify plagiarism or academic misconduct.
Improve the anthropomorphism of GenAI and reduce its mechanical nature	30	It is recommended that the results generated by GenAI should not be too stiff, as if they were written by a robot.
Promote the use of GenAI	25	Schools should encourage students to actively use GenAI, rather than prohibit it.
When using GenAI, focus on improving thinking skills	20	When using GenAI, attention should be paid to cultivating students' thinking skills.
Need to identify the content of GenAI output	17	The quality of the output content of GenAI should be identified, and the generated content should be used selectively on this basis.
Provide channels for the use of GenAI	14	It is hoped that GenAI tools can be used free of charge.
Develop diverse GenAI functions	12	It is hoped that a variety of GenAI functions can be developed to complete more tasks, such as analyzing data.
Reduce the homogeneity of the content generated by GenAI	10	It is recommended that GenAI pay attention to diversity and innovation when generating answers, and avoid content that is too similar.
Issue GenAI guidance specifications	9	Formulate management measures for the use of GenAI technology, and clarify the scope of use and code of conduct for teachers and students.
Carry out GenAI competitions or activities	4	Some competitions on GenAI can be carried out.
Pay attention to data security and privacy	3	Introduce privacy protection and data security policies for the use of technology to prevent the leakage of sensitive information.

4. Discussion

This study conducted a comprehensive survey on the present utilization of GenAI among university students, revealing its application characteristics and influencing factors in task scenarios, such as course learning, research activities, daily life and job search. Based on the statistical results, the following points are worth discussing.

Firstly, the survey shows that a majority of university students (79.1%) actively use GenAI (see Table 3), which is consistent with the conclusions of existing studies [4,27,45]. However, more than one-third of university students (34.2%) are not familiar with GenAI, and 9.7% of university students possess no knowledge of it at all (see Table 2), which may hinder their capacity to fully use the potential of GenAI to assist learning. This phenomenon may be attributed to students' limitations in knowledge, abilities, and experience with GenAI [46,47]. From the perspective of the TAM, individuals' adoption of new technologies mainly depends on perceived usefulness and perceived ease of use. When users believe that a technology is both helpful for improving work efficiency and easy to operate, they are more inclined to accept it and frequently use it [41]. In the current survey, although most students have recognized the potential usefulness of GenAI, some students' unfamiliarity with it may lead to their low perception of its ease of use, thereby weakening their overall willingness to adopt the technology. Therefore, to increase the popularity of GenAI and narrow the learning gap, universities should adopt effective strategies to help students learn GenAI knowledge and skills in a structured way, thereby enhancing their perceived ease of use and confidence and further promoting the widespread application of GenAI in learning.

The study also found that the GenAI tools used by university students are mainly products developed in China, and the usage rates of Doubao and ERNIE Bot are much higher than ChatGPT (see Figure 1). This research conclusion is different from existing studies [4,35,36,48], which found that ChatGPT is the most frequently used GenAI tool. This could potentially stem from ChatGPT's access restrictions in China. Local tools usually provide more open and free usage methods and are more in line with the needs and habits of Chinese university students in terms of language processing and functional design. Those tools can provide more natural and efficient support for Chinese university students, especially when dealing with learning tasks related to their first language. However, when Chinese university students deal with learning tasks in other or second languages, the advantages of local tools may not be brought into play due to cultural differences. Therefore, in order to fully tap the potential of GenAI tools, technology developers should strengthen the integration of local tools and international tools so that they can not only ensure the language and cultural adaptation of local students, but also provide professional support and services based on cultural differences.

Further analyzing the habits of university students in using GenAI, this study found that text generation (91.4%) and information search (81.5%) are the most commonly used GenAI functions (see Figure 2). This result is consistent with the findings of Yusuf et al., who pointed out that text generation and information retrieval are the most common applications of GenAI in the field of education [22]. However, other functions (such as voice generation, grammar checking, code generation, data analysis, reasoning ability, etc.) are less used, which may be related to the functional limitations of GenAI tools and disciplinary differences. Therefore, GenAI tools need to be optimized and designed with more targeted functions to more broadly support the learning needs and learning tasks of different disciplines, so as to fully realize their potential in higher education.

Secondly, there are differences in the use of GenAI by university students in four typical task scenarios. Among the four typical task scenarios, GenAI is most active in course learning (see Table 5). This is different from the conclusions of Li et al., who found that university students used GenAI most frequently in scientific research activities [39].

This difference may be related to the type of institution and academic environment of the research participants. The participants of the Li et al. survey were mainly undergraduates from a research university [39]. These students usually come into contact with scientific research projects earlier and have higher requirements for scientific research tasks. However, in ordinary undergraduate universities, the academic focus of university students is still on course learning. They have fewer opportunities to participate in scientific research. Therefore, they are more inclined to use GenAI in course-related tasks to improve learning efficiency and academic performance.

In course learning, university students gave the highest proportion of GenAI use to completing assignments (87.9%), which indicates that GenAI is increasingly serving as a tool for students to fulfill academic assignments, and its powerful text generation ability can help students complete academic tasks quickly. However, this convenience comes with potential drawbacks. GenAI may make students too dependent on tools, which could hinder their ability to think critically and come up with new ideas [4,36]. Therefore, it is necessary for teachers to rethink the design of students' assignments, and they can assign more open and innovative tasks to allow GenAI to assist with basic work [49]. Similarly, more than three-quarters of university students use GenAI to check information (85.4%), evaluate assignments (76.3%), and answer teachers' questions (76.2%), which further shows that GenAI has emerged as a significant learning tool. With its powerful information processing and feedback capabilities, students can not only quickly obtain learning materials and answer teachers' questions but also use tools to objectively evaluate their learning performance. This immediacy and interactivity can meet students' needs for personalized learning [50]. When teachers show students how to use GenAI, they should stress how important it is to help them learn how to sort through and analyze the data it generates, so that students do not just accept what the tool gives them without question, and so that the quality of learning can be controlled.

In research activities, university students frequently use GenAI to assist in the writing (78.8%) and revision of academic papers (69.8%). The use of GenAI in academic research, particularly in text generation, language enhancement, and structural modification, has emerged as a crucial instrument for improving the efficiency of academic writing. The survey also revealed that 67.1% of university students used GenAI to assist in selecting research questions. This finding shows that GenAI can combine different databases and look for research gaps, making it a great conversational learning tool [16] that can help students with their research problems. In addition, more than 60% of university students used GenAI for translating foreign materials (66.0%) and extracting key information from literature (62.1%), which shows that GenAI can significantly improve the efficiency of literature reading and provide students with a way to quickly obtain core information, especially when faced with a large amount of foreign literature.

In the field of daily life, 71.6% of university students use GenAI to obtain common sense or social, historical, geographical, cultural, and other related information. These data show that the main role of GenAI in daily life is to work as an "information assistant", aiding students in swiftly and correctly finding life information. Of the university students, 51.2% will look to GenAI for assistance when facing difficulties in areas such as nutrition, financial management, and social interactions. This indicates that GenAI functions not just as a knowledge resource but also as a practical life consultant who can provide personalized advice based on students' specific needs [3]. Moreover, GenAI has become an entertainment tool and psychological counseling tool for a small number of students [51]. It offers both emotional support and enjoyment for students while also serving as a "virtual companion" in everyday life.

In the field of job searching, the proportion of university students using GenAI is relatively low, which is consistent with previous research results [39]. A limited percentage

of university students use GenAI for employment information recommendations (9.5%), resume creation or revision (8.4%), and interview simulations (3.5%). Senior students may be more likely to use related services due to the pressure of job seeking. In fact, further analysis found that even seniors seldom use GenAI in the job search process. The TTF theory states that the effectiveness of technology depends on the degree of match between its functions and task requirements [52]. However, in the field of job search, GenAI currently has functional limitations—the generated job information is not accurate enough, and the resumés produced lack personalization and professionalism. In other words, the current functions of GenAI fail to fully fit the actual needs of the job search process, thus weakening its attractiveness and practicality. Therefore, in order to improve the application effect of GenAI in the field of job search, technology developers should focus on strengthening its accuracy and personalized customization capabilities and improving the match between GenAI technology and job search tasks. This will not only increase university students' acceptance of GenAI-assisted job search services but also help improve their overall performance in career development support.

Thirdly, grades and majors have a significant impact on university students' use of GenAI. In terms of gender (see Table 6), although males generally use GenAI more frequently than females in course learning, research activities, daily life, and job searching, this difference did not reach statistical significance ($p > 0.05$). This result is consistent with previous studies [30], indicating that the differences in behavior and attitudes between males and females in the use of technology are narrowing. In terms of grades (see Table 7), there are significant differences in the use of GenAI by university students of different grades in the fields of course learning ($p < 0.001$), research activities ($p < 0.001$), and job searching ($p = 0.002$). Specifically, the use frequency among senior students is much greater than that of younger students, maybe due to the complexity of learning assignments, specialized functional needs, and technical proficiency.

In terms of majors (see Table 8), Arts students use GenAI significantly more frequently in course learning ($p < 0.001$) and research activities ($p < 0.001$) than in engineering, science, and agricultural majors. This may be because humanities students rely more on text-processing functions, and GenAI has more prominent application advantages in this regard. Students majoring in science, engineering, and agriculture tend to use GenAI for formula reasoning, engineering calculations, code generation, and data analysis. However, GenAI still has certain limitations in mathematical calculations, logical reasoning, and data analysis, which may limit its widespread application in these fields. Studies have shown that only a small number of students (18.5%) use GenAI to solve numerical problems [4]. McKinsey Consulting also pointed out that GenAI, as a subset of artificial intelligence, is good at generating text but lacks in analyzing and interpreting existing data [43]. Therefore, technology developers should pay more attention to GenAI's capabilities in data processing, mathematical reasoning, and scientific computing so that it can better serve students from different disciplinary backgrounds. In addition, universities should provide customized training for different disciplines or majors to ensure that students can fully tap into the application potential of GenAI in their respective fields.

Finally, university students proposed several valuable recommendations for the use of GenAI. Through coding analysis, the researchers found that the frequency of offering relevant courses or lectures was the highest (see Table 9), which reflects university students wanting to learn GenAI technology in a structured way [35,53]. The poll found that more than half of university students (58.1%) actively learn how to use GenAI (see Table 4). However, most of them access this information from self-media platforms (83.3%) and knowledge-sharing platforms (65.8%) (see Figure 3). The fragmentary nature of these learning channels might make it harder for students to fully understand and master GenAI

technology, which would make it less useful in real life. Therefore, universities need to meet the educational needs of students by providing relevant elective courses, online courses, or lectures to systematically train the basic knowledge and skills of GenAI. University teachers should actively deploy and implement GenAI-based teaching in classroom teaching.

Many students made the point that we should avoid abusing GenAI tools to prevent plagiarism, academic misconduct, and other unethical behaviors (see Table 9). GenAI is a double-edged sword. While it brings convenience to university students' studies and lives, it also has potential negative effects [34]. It may promote dishonest behaviors such as plagiarism and cheating [54]. At the same time, students' overreliance on technology may diminish their higher-order cognitive skills, including critical thinking and problem-solving [4]. Therefore, universities should promptly issue guidance standards or policies for GenAI and help students correctly understand and reasonably use it by establishing clear codes of conduct and strengthening supervision and management. Unfortunately, guidance standards or policies for GenAI are still in the initial exploration stage. Xiao et al. found that among the top 500 universities in the world, less than one-third of them have formulated policies for the use of AI [55]. Among universities with AI policies, 14% have guidelines for students on how to use AI ethically [55]. In addition, Almossaad et al. found that only 19.2% of students were aware of the rules or guidelines their university had established for the responsible use of these technologies [4].

A multitude of students also suggested improving the accuracy of GenAI and developing diverse functions from the perspective of technology development and optimization. They also proposed reducing the homogeneity and mechanical nature of the content generated by GenAI and paying attention to data security and privacy (see Table 9). This indicates that university students have certain concerns about the quality of outcomes produced by GenAI and the security of the technology throughout its use. Amoozadeh et al. discovered that almost 50% of students lacked confidence in the quality of GenAI output, while just 25% considered it beneficial [53]. Therefore, technology developers should enhance GenAI in these areas to improve user experience and trust. In addition, some students suggested that universities should advocate for the use of GenAI, provide channels for the use of GenAI, and carry out competitions or activities for GenAI. These suggestions provide useful references for universities to formulate policies related to GenAI and help to better integrate it into teaching and scientific research practices.

5. Research Limitations and Future Research

Although this study provides useful insights into the application and influencing factors of GenAI in higher education, there are still some limitations.

A major limitation of this study is the small sample size. Only undergraduate students at Guangxi Baise University participated in the survey. The results may not represent the use of GenAI by university students in other regions. In order to improve the wide applicability of the research results, future research should expand the sample range to cover more students from different universities and regions.

Another limitation of this study is the research method. This study mainly used a cross-sectional survey method, which can represent the students' use of GenAI at a specific point in time, but cannot effectively evaluate the long-term impact of GenAI on students' learning and research. Therefore, future research can adopt a longitudinal research design to collect data multiple times over a longer period of time, so as to more comprehensively track and analyze students' use of GenAI. The researchers mainly used self-report instruments to gather data. The reliability of the data depends on the respondents' understanding of the concepts and their attitudes toward the questionnaire answers. Since respondents may have misunderstandings or subjective biases about the research variables, this may

affect data accuracy and research credibility. So, to fully understand the situation and experience of students using GenAI, future research could use a mixed method that includes both qualitative interviews and quantitative data. In addition, other methods, such as experimental methods, could be used to evaluate the actual impact of the use of GenAI on learning behavior and learning outcomes.

6. Conclusions

This study reveals the challenges university students face in using GenAI. The results indicate that while most university students actively use GenAI, a considerable number of students are unfamiliar with the technology. Of the four typical task scenarios, the application of GenAI in daily life and job search is relatively limited, indicating that there are potential areas for further development. It is worth noting that there are significant differences between different disciplines and grades, with the frequency of use among freshmen and sophomores being significantly lower than that among juniors and seniors, and the frequency of use in engineering, science, and agriculture majors being lower than that in arts. In addition, university students also raised concerns about academic misconduct, over-reliance on technology, and data security.

This study provides suggestions for universities, education administration departments, and technology development departments to improve GenAI services. Universities should build a systematic GenAI training system. By developing GenAI courses and lectures, universities can focus on guiding university students on the basic knowledge and common methods of using GenAI. For different grades and subjects, universities should adopt phased and customized teaching plans to gradually improve university students' cognition of and operational skills in GenAI, thereby enhancing their perceived ease of use and technical confidence. University teachers should actively integrate GenAI tools into the class and improve GenAI literacy by setting more open and advanced learning tasks. Educational administrative departments should jointly formulate clear guidelines and ethical standards for the use of GenAI, and strengthen data privacy protection and information security management. When formulating policies, they should take into account issues such as preventing academic misconduct and technology abuse. Technology development departments should provide more accurate and personalized services to overcome the current shortcomings of GenAI in data analysis, logical reasoning, and job hunting. Technology developers should also optimize GenAI's interactive design and operating procedures to further stimulate college students' enthusiasm for application.

This study contributes to the achievement of sustainable development goals for higher education. On the one hand, this study investigated the current status of university students' use of GenAI. It will help universities carry out targeted guidance based on the characteristics of their students. It will help universities optimize the allocation of educational resources and improve teaching efficiency. It will help students enhance AI literacy to adapt to the future. On the other hand, this study focuses on general university students from mainland China and explores their differences and views on using GenAI under various demographic factors. It is of enormous value in exploring the differences in the use of GenAI by university students from different cultural backgrounds. It helps promote educational equity and inclusiveness and supports cross-cultural research.

Author Contributions: Conceptualization, L.X., H.S.P. and Z.Z.; methodology, L.X.; software, L.X.; validation, H.S.P. and A.F.M.A.; formal analysis, L.X. and Z.Z.; investigation, L.X. and Z.Q.; data curation, L.X.; writing—original draft preparation, L.X. and Z.Z.; writing—review and editing, H.S.P., A.F.M.A., J.G. and Z.Q.; visualization, J.G.; supervision, H.S.P. and A.F.M.A.; project administration, H.S.P. and A.F.M.A.; funding acquisition, Z.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and obtained ethical approval from the Research Department of Baise University (approval number: 2013051; Date: 27 December 2024).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are contained within the article.

Acknowledgments: The authors are indebted to the Baise University. We are also grateful to all survey respondents for their time and effort.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Sengar, S.S.; Hasan, A.B.; Kumar, S.; Carroll, F. Generative artificial intelligence: A systematic review and applications. *Multimed. Tools Appl.* **2024**, *83*, 1–40. [CrossRef]
2. Chiu, T.K. Future research recommendations for transforming higher education with generative AI. *Comput. Educ. Artif. Intell.* **2024**, *6*, 100197. [CrossRef]
3. Chan, C.K.Y.; Hu, W. Students' voices on generative AI: Perceptions, benefits, and challenges in higher education. *Int. J. Educ. Technol. High. Educ.* **2023**, *20*, 43. [CrossRef]
4. Almassaad, A.; Alajlan, H.; Alebaikan, R. Student perceptions of generative artificial intelligence: Investigating utilization, benefits, and challenges in higher education. *Systems* **2024**, *12*, 385. [CrossRef]
5. Alalmaq, A.S. The History of the Artificial Intelligence Revolution and the Nature of Generative AI Work. *J. Artif. Intell. Robot.* **2024**, *2*, 1–24.
6. Natale, S. If software is narrative: Joseph Weizenbaum, artificial intelligence and the biographies of ELIZA. *New Media Soc.* **2019**, *21*, 712–728. [CrossRef]
7. Weizenbaum, J. ELIZA—A computer program for the study of natural language communication between man and machine. *Commun. ACM* **1966**, *9*, 36–45. [CrossRef]
8. Balasubramaniam, S.; Chirchi, V.; Kadry, S.; Agoramoorthy, M.; Gururama, S.P.; Satheesh, K.K.; Sivakumar, T. The Road Ahead: Emerging Trends, Unresolved Issues, and Concluding Remarks in Generative AI—A Comprehensive Review. *Int. J. Intell. Syst.* **2024**, *2024*, 1–38.
9. Hadi, M.U.; Qureshi, R.; Shah, A.; Irfan, M.; Zafar, A.; Shaikh, M.B.; Akhtar, N.; Wu, J.; Mirjalili, S. A survey on large language models: Applications, challenges, limitations, and practical usage. *Authorea Prepr.* **2023**, *3*, 1–30.
10. Alto, V. *Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4*; Packt Publishing Ltd.: Birmingham, UK, 2023.
11. Baptista, E. China Leads the World in Adoption of Generative AI, Survey Shows. *Reuters*, 9 July 2024. Available online: <https://www.reuters.com/technology/artificial-intelligence/china-leads-world-adoption-generative-ai-survey-shows-2024-07-09/> (accessed on 10 July 2024).
12. *55th Statistical Report on the Development of China's Internet*; China Internet Network Information Center: Beijing, China, 2025.
13. Nikolopoulou, K. Generative artificial intelligence and sustainable higher education: Mapping the potential. *J. Digit. Educ. Technol.* **2025**, *5*, ep2506. [CrossRef]
14. Barrett, A.; Pack, A. Not quite eye to AI: Student and teacher perspectives on the use of generative artificial intelligence in the writing process. *Int. J. Educ. Technol. High. Educ.* **2023**, *20*, 59. [CrossRef]
15. Kim, J.; Yu, S.; Detrick, R.; Li, N. Exploring students' perspectives on generative AI-assisted academic writing. *Educ. Inf. Technol.* **2024**, *30*, 1265–1300. [CrossRef]
16. Dai, Y.; Liu, A.; Lim, C.P. Reconceptualizing ChatGPT and generative AI as a student-driven innovation in higher education. *Procedia CIRP* **2023**, *119*, 84–90. [CrossRef]
17. Zhao, J.; Chapman, E.; Sabet, P.G. Generative AI and Educational Assessments: A Systematic Review. *Educ. Res. Perspect.* **2024**, *51*, 124–155. [CrossRef]
18. Rutherford, S.; Pritchard, C.; Francis, N. Assessment IS learning: Developing a student-centred approach for assessment in Higher Education. *FEBS Open Bio* **2025**, *15*, 21–34. [CrossRef]
19. Borah, A.R.; Nischith, T.; Gupta, S. Improved learning based on GenAI. In Proceedings of the 2024 2nd International Conference on Intelligent Data Communication Technologies and Internet of Things (IDCIoT), Bengaluru, India, 4–6 January 2024; pp. 1527–1532.

20. Beirat, M.A.; Tashtoush, D.M.; Khasawneh, M.A.; Az-Zo'bi, E.A.; Tashtoush, M.A. The Effect of Artificial Intelligence on Enhancing Education Quality and Reduce the Levels of Future Anxiety among Jordanian Teachers. *Appl. Math* **2025**, *19*, 279–290.
21. Boscardin, C.K.; Gin, B.; Golde, P.B.; Hauer, K.E. ChatGPT and generative artificial intelligence for medical education: Potential impact and opportunity. *Acad. Med.* **2024**, *99*, 22–27. [[CrossRef](#)] [[PubMed](#)]
22. Yusuf, A.; Pervin, N.; Román-González, M. Generative AI and the future of higher education: A threat to academic integrity or reformation? Evidence from multicultural perspectives. *Int. J. Educ. Technol. High. Educ.* **2024**, *21*, 21. [[CrossRef](#)]
23. Kurtz, G.; Amzalag, M.; Shaked, N.; Zaguri, Y.; Kohen-Vacs, D.; Gal, E.; Zailer, G.; Barak-Medina, E. Strategies for integrating generative AI into higher education: Navigating challenges and leveraging opportunities. *Educ. Sci.* **2024**, *14*, 503. [[CrossRef](#)]
24. Kamalov, F.; Santandreu Calonge, D.; Gurrib, I. New era of artificial intelligence in education: Towards a sustainable multifaceted revolution. *Sustainability* **2023**, *15*, 12451. [[CrossRef](#)]
25. George, A.S.; Baskar, T.; Srikanth, P.B. The erosion of cognitive skills in the technological age: How reliance on technology impacts critical thinking, problem-solving, and creativity. *Partn. Univers. Innov. Res. Publ.* **2024**, *2*, 147–163.
26. Giannakos, M.; Azevedo, R.; Brusilovsky, P.; Cukurova, M.; Dimitriadis, Y.; Hernandez-Leo, D.; Järvelä, S.; Mavrikis, M.; Rienties, B. The promise and challenges of generative AI in education. *Behav. Inf. Technol.* **2024**, *43*, 1–27. [[CrossRef](#)]
27. Arowosegbe, A.; Alqahtani, J.S.; Oyelade, T. Perception of generative AI use in UK higher education. In *Frontiers in Education*; Frontiers Media SA: Lausanne, Switzerland, 2024; p. 1463208.
28. Saúde, S.; Barros, J.P.; Almeida, I. Impacts of Generative Artificial Intelligence in Higher Education: Research Trends and Students' Perceptions. *Soc. Sci.* **2024**, *13*, 410. [[CrossRef](#)]
29. Aldossary, A.S.; Aljindi, A.A.; Alamri, J.M. The role of generative AI in education: Perceptions of Saudi students. *Contemp. Educ. Technol.* **2024**, *16*, ep536. [[CrossRef](#)] [[PubMed](#)]
30. Gasaymeh, A.-M.M.; Beirat, M.A.; Abu Qbeita, A.a.A. University Students' Insights of Generative Artificial Intelligence (AI) Writing Tools. *Educ. Sci.* **2024**, *14*, 1062. [[CrossRef](#)]
31. Vo, A.; Nguyen, H. Generative artificial intelligence and ChatGPT in language learning: EFL students' perceptions of technology acceptance. *J. Univ. Teach. Learn. Pract.* **2024**, *21*, 199–218. [[CrossRef](#)]
32. Obenza, B.-N.; Salvahan, A.; Rios, A.-N.; Solo, A.; Alburo, R.-A.; Gabila, R.-J. University students' perception and use of ChatGPT: Generative artificial intelligence (AI) in higher education. *Int. J. Hum. Comput. Stud.* **2024**, *5*, 5–18.
33. Abdullah, Z.; Zaid, N.M. Perception of generative artificial intelligence in higher education research. *Innov. Teach. Learn. J.* **2023**, *7*, 84–95. [[CrossRef](#)]
34. Baidoo-Anu, D.; Ansah, L.O. Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning. *J. AI* **2023**, *7*, 52–62. [[CrossRef](#)]
35. Jingwei He, A.; Zhang, Z.; Anand, P.; McMinn, S. Embracing generative artificial intelligence tools in higher education: A survey study at the Hong Kong University of Science and Technology. *J. Asian Public Policy* **2025**, *17*, 1–25. [[CrossRef](#)]
36. Baek, C.; Tate, T.; Warschauer, M. "ChatGPT seems too good to be true": College students' use and perceptions of generative AI. *Comput. Educ. Artif. Intell.* **2024**, *7*, 100294. [[CrossRef](#)]
37. Qu, Y.; Tan, M.X.Y.; Wang, J. Disciplinary differences in undergraduate students' engagement with generative artificial intelligence. *Smart Learn. Environ.* **2024**, *11*, 51. [[CrossRef](#)]
38. Liu, Y.; Park, J.; McMinn, S. Using generative artificial intelligence/ChatGPT for academic communication: Students' perspectives. *Int. J. Appl. Linguist.* **2024**, *34*, 1437–1461. [[CrossRef](#)]
39. Yan, L.; Jie, X.; Yuan, J.C.; Song, Z.X. Investigation of College Students' Generative Artificial Intelligence (GAI) Usage Status and its Implication. *Open Educ. Res.* **2024**, *30*, 89–98.
40. Marangunić, N.; Granić, A. Technology acceptance model: A literature review from 1986 to 2013. *Univers. Access Inf. Soc.* **2015**, *14*, 81–95. [[CrossRef](#)]
41. Davis, F.D. Technology acceptance model: TAM. *Al-Suqri MN Al-Aufi AS Inf. Seek. Behav. Technol. Adopt.* **1989**, *205*, 5.
42. Goodhue, D.L.; Thompson, R.L. Task-technology fit and individual performance. *MIS Q.* **1995**, *19*, 213–236. [[CrossRef](#)]
43. Yilmaz, R.; Yilmaz, F.G.K. Augmented intelligence in programming learning: Examining student views on the use of ChatGPT for programming learning. *Comput. Hum. Behav. Artif. Hum.* **2023**, *1*, 100005. [[CrossRef](#)]
44. Miles, M.B.; Huberman, A.M. *Qualitative Data Analysis: An Expanded Sourcebook*; SAGE: Newcastle upon Tyne, UK, 1994.
45. Johnston, H.; Wells, R.F.; Shanks, E.M.; Boey, T.; Parsons, B.N. Student perspectives on the use of generative artificial intelligence technologies in higher education. *Int. J. Educ. Integr.* **2024**, *20*, 2. [[CrossRef](#)]
46. Kelly, A.; Sullivan, M.; Strampel, K. Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *J. Univ. Teach. Learn. Pract.* **2023**, *20*, 1–16. [[CrossRef](#)]
47. Von Garrel, J.; Mayer, J. Artificial Intelligence in studies—Use of ChatGPT and AI-based tools among students in Germany. *Humanit. Soc. Sci. Commun.* **2023**, *10*, 1–9. [[CrossRef](#)]

48. Guillén-Yparrea, N.; Hernández-Rodríguez, F. Unveiling generative AI in higher education: Insights from engineering students and professors. In Proceedings of the 2024 IEEE Global Engineering Education Conference (EDUCON), Kos Island, Greece, 8–11 May 2024; pp. 1–5.
49. Li, H.; Wang, W. Design and evaluation of student assignments in the era of generative artificial intelligence. *Open Educ. Res.* **2023**, *29*, 31–39.
50. Rawas, S. ChatGPT: Empowering lifelong learning in the digital age of higher education. *Educ. Inf. Technol.* **2024**, *29*, 6895–6908. [[CrossRef](#)]
51. Ya, S.Y. Digital intelligence psychology: Opportunities and challenges of AI empowering mental health. *Glob. Commun. J.* **2023**, *10*, 1–4.
52. Zigurs, I.; Buckland, B.K. A theory of task/technology fit and group support systems effectiveness. *MIS Q.* **1998**, *22*, 313–334. [[CrossRef](#)]
53. Amoozadeh, M.; Daniels, D.; Nam, D.; Kumar, A.; Chen, S.; Hilton, M.; Srinivasa Ragavan, S.; Alipour, M.A. Trust in Generative AI among Students: An exploratory study. In Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1, New York, NY, USA, 20–23 March 2024; pp. 67–73.
54. Hosseini, M.; Gao, C.A.; Liebovitz, D.M.; Carvalho, A.M.; Ahmad, F.S.; Luo, Y.; MacDonald, N.; Holmes, K.L.; Kho, A. An exploratory survey about using ChatGPT in education, healthcare, and research. *PLoS ONE* **2023**, *18*, e0292216. [[CrossRef](#)]
55. Xiao, P.; Chen, Y.; Bao, W. Waiting, banning, and embracing: An empirical analysis of adapting policies for generative AI in higher education. *arXiv* **2023**, arXiv:2305.18617. [[CrossRef](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.