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Exploring the Application of ChatGPT in Graduate Neuroscience Education

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Abstract: With artificial intelligence's rapid progress, language models like ChatGPT are entering higher education, offering opportunities and risks. We surveyed faculty and graduate students at Henan Medical University to examine ChatGPT's role in graduate neuroscience teaching. Quantitative analyses profiled awareness, usage patterns, perceived roles, effectiveness, and concerns. Overall usage remained below 50%. Faculty and students most often used ChatGPT for reference consultation, research support, and academic writing; user experience was generally positive. Respondents reported benefits for information and resource integration (78.42%), comprehension of complex concepts (74.10%), learning interest and engagement (62.59%), personalized learning (50.36%), and timely feedback with abundant resources (65.47%). Nevertheless, participants highlighted challenges including information accuracy, academic integrity, and technological dependence, which could impede independent learning and critical thinking. Many favored broader, well-guided adoption paired with training. We conclude that ChatGPT can meaningfully support graduate neuroscience education when integrated with human instruction, rigorous verification, and clear ethical safeguards. Future work should evaluate learning outcomes longitudinally, develop evidence-based implementation frameworks, and address equity and privacy to realize sustainable impact in specialized domains.

Keywords: Generative artificial intelligence; Usage patterns; Self-regulated learning; Academic integrity; Survey report

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1. Introduction

Since its initial release in November 2022, the artificial intelligence (AI) program ChatGPT has come to be widely recognized by scholars and the public alike, rapidly making waves across culture, education, science, programming, and healthcare. ChatGPT—short for Chat Generative Pre-trained Transformer—is a language model trained with reinforcement learning from human feedback (RLHF). Its strength lies in understanding and generating fluent, coherent natural language, thereby enabling natural dialogue and interaction with users (https://openai.com/index/chatgpt/). Trained on vast corpora spanning diverse topics and domains, it supports

multiple languages and can learn user preferences through interaction and contextual linkage to provide more personalized responses. In addition, it can help users solve problems, offer suggestions, and exhibit a degree of creativity—for example, writing code, producing images, and even drafting academic manuscripts [1]. While ChatGPT's rapid development and widespread adoption present major opportunities for education, they also bring challenges and risks related to academic integrity, educational inequality, and data security.

The 21st century is widely regarded as the era of brain science, and the importance of neuroscience research and education is increasingly recognized. Neuroscience has emerged in response—an inherently interdisciplinary field emphasizing cross-fertilization across multiple disciplines, levels, and scales. This interdisciplinary nature makes neuroscience both crucial and particularly challenging to teach. In recent years, many well-known universities worldwide have launched neuroscience courses to foster a comprehensive understanding of the brain and its functions. However, given the sheer volume of information, the pace of disciplinary development, and the complexity of content, neuroscience education faces significant challenges. Students must grasp the brain's complex operations across multiple levels and dimensions while integrating knowledge from different fields to form a holistic understanding of neural phenomena. Moreover, many concepts in neuroscience are abstract and elusive, making it difficult for students to understand theoretical knowledge or its practical applications. Consequently, instructors urgently need innovative teaching approaches to simplify complex material, boost student engagement, and help learners adapt to the rapid evolution of the field. AI tools such as ChatGPT are beginning to reveal distinctive advantages in education and are quietly reshaping how students learn and how instructors teach [2]. Especially in higher education, AI opens new possibilities for personalized learning, knowledge acquisition, and increased student participation—creating new opportunities for neuroscience instruction.

However, as ChatGPT becomes more widely used, students may over-rely on it to complete assignments, write papers, or even generate original research ideas, which could lead to potential plagiarism issues and a decline in independent critical thinking [3,4]. Ensuring that ChatGPT complements rather than replaces traditional learning methods is essential for maintaining academic standards. The accuracy of information provided by ChatGPT must also be scrutinized. Although trained on large datasets, the model may still generate inaccurate or misleading content when dealing with highly specialized or niche topics such as neuroscience. Given the premium placed on precision in scientific fields like neuroscience, misinformation can have serious consequences for research or clinical practice. Instructors must therefore guide students to cultivate the ability to critically evaluate information when using ChatGPT. Another challenge is educational inequality: despite ChatGPT's power, not all students have equal access to it. Learners in under-resourced schools or from low-income families may be unable to benefit from advanced AI tools, potentially exacerbating existing disparities. In addition, students lacking digital literacy may struggle to use these tools effectively, further widening educational gaps. To fully leverage the educational benefits of ChatGPT while mitigating potential risks, more in-depth research is needed to explore optimal strategies for integrating such tools into teaching systems. In this way, educational institutions can enhance learning outcomes while safeguarding academic integrity and educational equity. This article offers an initial exploration of the applications and challenges of ChatGPT in graduate-level neuroscience education.

2. Materials and methods

2.1. Participants

Faculty members and graduate students at Henan Medical University were recruited as survey respondents. An

electronic questionnaire was administered from June 22 to July 3, 2025.

2.2. Methods

Drawing on an extensive review of relevant literature and materials, we designed a questionnaire themed "Applications and Challenges of ChatGPT in Neuroscience Education." The aim was to quantitatively assess faculty and students' awareness and usage of ChatGPT and to explore its potential benefits and issues in neuroscience teaching. The questionnaire covered four main areas: (1) respondents' level of awareness of ChatGPT, including understanding of its functions, underlying techniques, and potential roles in education; (2) usage patterns, analyzing how frequently and for what purposes instructors and students use ChatGPT in teaching or learning, as well as specific application scenarios; (3) evaluation of ChatGPT's applicability in neuroscience teaching and learning, with emphasis on its effectiveness in course design, research support, and assignment/tutoring; and (4) appraisal of advantages and disadvantages, including perceived contributions to instructional efficiency, knowledge integration, and personalized learning, alongside concerns about academic integrity, information accuracy, and technological dependence.

To ensure effective and broad data collection, the online survey platform "Wenjuanxing" (https://www.wjx.cn/) was used to create and distribute the questionnaire. Responses were collected anonymously to protect participants' privacy and to ensure the authenticity and objectivity of the data.

2.3. Statistical analysis

Descriptive statistics were generated by Wenjuanxing. Cross-tabulation analyses and Fisher's exact tests were performed using SPSS 26. A two-sided $P < 0.05$ was considered statistically significant.

3. Results

A total of 139 questionnaires were collected, all of which were valid ($n = 139$). Of these, 57 were from faculty (41.01%) and 82 from students (58.99%).

3.1. Usage rate of ChatGPT

Among faculty, 22 individuals reported having used ChatGPT in teaching or learning (including daily, weekly, or monthly use), accounting for 38.59% of all faculty; among students, 37 reported having used ChatGPT, accounting for 45.12%. By contrast, 61.40% of faculty and 54.88% of students had never used ChatGPT. These findings suggest that in medical education at universities in central–western China, the penetration and usage rates of ChatGPT remain relatively low (**Table 1**). Although the potential of generative AI tools is increasingly recognized and explored by both instructors and students, actual day-to-day use in teaching and learning is far from widespread.

Analysis of daily and monthly usage frequencies revealed a significant difference between faculty and students ($P = 0.014$). Specifically, 10.53% of faculty reported using ChatGPT daily, compared with only 2.44% of students, indicating that faculty use ChatGPT significantly more frequently in their routine work. This higher frequency among faculty may relate to heavier teaching and research workloads and greater reliance on generative AI for rapid information access, instructional material design, and research support. Students, by contrast, tended to use ChatGPT intermittently: the proportion reporting monthly use reached 34.15%, notably higher than the 14.04% observed among faculty. This difference may stem from students' less frequent day-to-day need for ChatGPT or incomplete familiarity with its full functionality, leading them to use it primarily for

specific tasks or assignments (**Table 1**).

Table 1. Frequency of ChatGPT use among faculty and students [*n* (%)]

Item	Daily	Weekly	Monthly	Never
Faculty	6 (10.53) a	8 (14.04) a,b	8 (14.04) b	35 (61.4) a,b
Students	2 (2.44) a	7 (8.54) a,b	28 (34.15) b	45 (54.88) a,b
Total	8 (5.76)	15 (10.79)	36 (25.9)	80 (57.55)

Note: Lowercase letters a and b indicate significant differences, $P < 0.05$.

Overall, faculty who use ChatGPT tend to do so weekly or even daily, whereas student usage is relatively lower and more often monthly. These patterns reflect faculty's more immediate practical needs for ChatGPT in teaching and research, while students are more likely to treat it as an auxiliary tool for particular tasks. The data in **Table 1** also indicate that, despite an emerging foothold in medical education, broad adoption of ChatGPT in some developing regions has yet to be fully realized. In particular, guiding students to use this tool reasonably and efficiently remains an important direction for future educational reform.

3.2. Purposes of using ChatGPT

Faculty and students use ChatGPT for a wide variety of purposes, ranging from information lookup to research support, learning, and writing. Specifically, faculty primarily use ChatGPT for literature/information retrieval (35.09%), academic research and writing (29.82%), course design or research project design (28.07%), course learning and assignment tutoring (19.30%), and leisure/entertainment (10.53%). These figures suggest that, beyond teaching duties, faculty often face substantial research pressure and therefore tend to employ ChatGPT as a tool to support scholarly work and course design—helping them organize materials, draft academic papers, and plan courses or research projects.

By contrast, students' purposes show some differences. Although students also use ChatGPT mainly for information retrieval, academic writing, and coursework, their use for course learning and assignment support is higher than that of faculty, reaching 31.71% (**Figure 1**). This likely reflects students' primary focus on academic tasks—completing coursework, assignments, and exam preparation—where ChatGPT can offer timely study assistance and problem-solving ideas. In particular, when faced with difficult neuroscience concepts, ChatGPT can provide simplified explanations and additional learning resources.

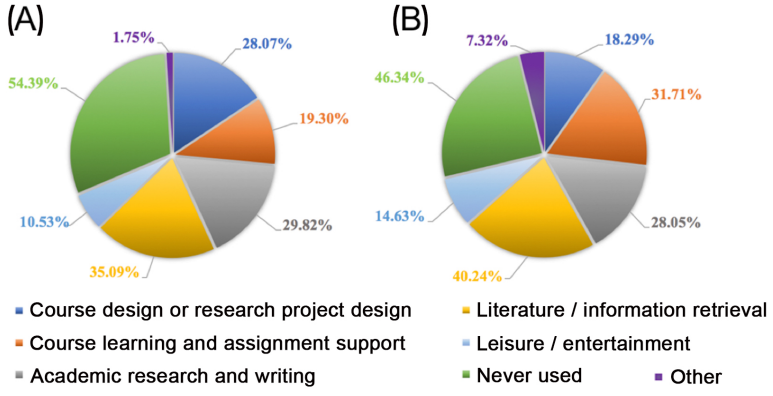

Figure 1. Purposes of ChatGPT use among faculty and students. (A) Proportion of purposes reported by faculty; (B) Proportion of purposes reported by students. For multiple-response items, the percentage for each option = (number of selections for that option) ÷ (number of valid questionnaires).

On the other hand, students report a lower proportion of use for course design or research project design—only 18.29%, far below the 28.07% among faculty. This difference may reflect the fact that students are mainly in the learning stage and have not yet broadly engaged in independently planning course design or research topics, relying more on instructors' guidance. Faculty, needing to continuously update teaching content and research agendas, often leverage ChatGPT for cross-disciplinary knowledge integration and project design to improve work efficiency.

3.3. Trust in and user experience with ChatGPT

Faculty and students considered ChatGPT relatively reliable in providing accurate information (56.83%). In this survey population, more than half were only familiar with ChatGPT but had not actually used it. As is well known, ChatGPT is more than a simple tool for information lookup. Although it operates via a conversational interface, its powerful learning and generative capabilities require careful development and accurate, effective application in practice. Accordingly, professional training is essential: 83.45% of respondents were willing or very willing to participate in training on how to use ChatGPT; only 5.02% were unwilling or very unwilling, and another 11.51% were uncertain—likely because they had not used or did not understand ChatGPT.

In addition, overall user experience with ChatGPT was favorable. Among respondents who had used ChatGPT, 11.51% and 41.73% rated the experience as "very good" and "good," respectively; 23.74% rated it "average." No respondents rated their experience as "poor" or "very poor."

3.4. Applicability of ChatGPT in graduate neuroscience education

Among respondents who had used ChatGPT, the tool was generally perceived as highly applicable to neuroscience teaching. The vast majority rated it "highly applicable" or "applicable," indicating that ChatGPT can provide effective support in this domain. Only 1.44% considered it "not applicable" or "highly inapplicable" ($P = 0.236$; **Table 2**), suggesting overall positive evaluations of its functionality and educational impact.

Table 2. Perceived applicability of ChatGPT in neuroscience education among faculty and students [*n* (%)]

Applicability	Faculty	Students	Total
Highly applicable	5 (8.77)	15 (18.29)	20 (14.39)
Applicable	25 (43.86)	35 (42.68)	60 (43.17)
Uncertain	27 (47.37)	30 (36.59)	57 (41.01)
Not applicable	0 (0)	2 (2.44)	2 (1.44)
Highly inapplicable	0 (0)	0 (0)	0 (0)

3.5. The role of ChatGPT in neuroscience education

Faculty and students chiefly viewed ChatGPT's roles as: assisting instructors with course preparation and teaching (82.01%); supporting students' self-directed learning and problem-solving (80.58%); assessing students' learning progress and performance (41.73%); and other roles (6.47%). This suggests that most respondents at Henan Medical University consider ChatGPT better suited to addressing well-defined questions and offering comprehensive suggestions, while lacking functions for more complex tasks such as evaluation, feedback, and monitoring.

In addition, most faculty and students believed that using ChatGPT in graduate-level neuroscience teaching offers potential benefits such as: providing information and integrating resources (78.42%); increasing students'

interest and engagement (62.59%); helping students better understand and master complex neuroscience concepts (74.10%); delivering customized learning experiences based on students' progress and interests (50.36%); and supplying more learning resources and feedback (65.47%).

3.6. Effectiveness of ChatGPT in neuroscience education

Most respondents perceived ChatGPT as effective (56.12%, combining "very effective" and "somewhat effective"). Only 7.19% rated its effect as average, while 36.69% were uncertain—largely because they had not used ChatGPT. Furthermore, 69.79% believed ChatGPT should be more widely applied in neuroscience teaching; 25.90% were unsure due to limited familiarity; and only 4.32% felt that existing teaching methods are already sufficient and that broader adoption is unnecessary. Overall, among those who have used ChatGPT, the majority recognized its benefits and effectiveness and recommended wider implementation.

3.7. Potential problems and challenges of using ChatGPT in graduate neuroscience courses

Using ChatGPT in graduate neuroscience courses may entail several potential problems or challenges. More than half of faculty and students believed that: (1) ChatGPT cannot replace traditional classroom teaching; (2) ChatGPT has limitations—such as constraints inherent to language models and outdated information—which may lead to issues of accuracy, stability, and security; (3) Excessive reliance on ChatGPT could weaken students' self-directed learning, divergent thinking, critical thinking, and problem-solving skills.

In addition, over 40% of respondents thought that: (1) ChatGPT may not meet all students' learning needs and should be combined with other teaching methods; (2) The latest versions of ChatGPT are not free, which could exacerbate educational inequities, especially in regions with limited technological and financial resources; (3) Overreliance on ChatGPT in teaching may result in a lack of humanization and emotional interaction in the learning experience; (4) Using ChatGPT for assignments and academic papers may raise issues of academic integrity.

Some respondents also noted that ChatGPT may change instructors' roles and teaching methods, potentially introducing other problems detrimental to student learning. Overall, there remains skepticism and debate about employing ChatGPT as an advanced instructional aid, and further research and standard-setting are needed before adopting a ChatGPT-assisted model in graduate neuroscience education.

4. Discussion

Neuroscience originated from research in neuroanatomy and physiology. By analyzing the structure and function of the brain and nervous system, it has evolved from early basic studies to an interdisciplinary field spanning the molecular, cellular, systems, and behavioral levels into an independent and complex discipline. Neuroscience has not only advanced our understanding of the brain but has also propelled developments in medicine, psychology, artificial intelligence, and other fields. With accelerating technological progress and knowledge renewal, neuroscience research and applications have become increasingly broad and deep, posing numerous challenges for teaching in this domain.

In recent years, leading universities at home and abroad—such as Harvard University, the University of Cambridge, Tsinghua University, Zhejiang University, and Capital Medical University—have launched neuroscience-related courses aimed at cultivating students with a solid theoretical foundation and cross-disciplinary competencies. However, the hallmarks of neuroscience—multidisciplinary integration, technology-

driven inquiry, and multi-level investigation—make instruction particularly challenging, and traditional teaching approaches must be continuously upgraded to meet these new demands.

In November 2022, OpenAI released a free version of ChatGPT. The rapid dissemination and application of this generative AI have created new opportunities for learning and teaching. Recent surveys indicate that 49% of U.S. students were using AI writing tools in Fall 2023, up from just 27% in the spring, while teacher usage lagged behind that of students [5]. Another survey, however, reported that 63% of teachers in U.S. K-12 education had used ChatGPT—exceeding student usage—with teachers leveraging it for lesson planning and generating instructional materials to improve efficiency [6]. In our analysis, 38.59% of faculty and 45.12% of students at Henan Medical University had used ChatGPT, with the faculty proportion lower than that of students. These findings suggest that although ChatGPT has received widespread global attention and adoption, its use in some regional universities, particularly those in China's central and western areas, remains limited by technology diffusion and network constraints. We also observed that among those who had used ChatGPT, 10.53% of faculty reported daily use, compared with only 2.44% of students, significantly lower than faculty. This may be because ChatGPT can help instructors quickly locate and summarize the latest advances, techniques, and methods in neuroscience, integrate cross-disciplinary knowledge, and generate comprehensive teaching materials and course outlines. In addition to teaching duties, instructors also face substantial research demands, which may further contribute to their higher frequency of ChatGPT use.

Neuroscience is highly interdisciplinary, requiring the integration of knowledge across domains—a major challenge for both instructional design and student learning. As a generative AI tool trained on large-scale data and covering a wide range of topics and fields, ChatGPT offers new opportunities for learning and teaching in neuroscience. It can help instructors evaluate and upgrade classroom processes and facilitate course planning and implementation [7], while also providing adaptive experiences that emulate a human tutor's responsiveness and personalization to address issues of resources and specificity [8]. For instructors, ChatGPT primarily helps by: (1) rapidly locating and summarizing the latest advances, techniques, and methods in neuroscience, enabling timely course updates; (2) integrating cross-disciplinary knowledge to generate comprehensive teaching materials and course syllabi, helping students grasp the field's multidisciplinary nature; (3) supplying detailed information on experimental design, procedures, and precautions to support the design and delivery of laboratory and practicum courses; (4) offering clear, accessible explanations and analogies for complex neuroscience concepts to aid instruction; (5) generating teaching resources—such as handouts, slides, quizzes, and answer keys—saving time and effort. For students, ChatGPT primarily helps by: (1) answering questions about neuroscience concepts, theories, and experimental methods to support learning and review; (2) providing step-by-step guidance and problem-solving ideas when difficulties arise with assignments; (3) recommending relevant textbooks, papers, videos, and online courses to deepen and broaden learning; (4) offering programming assistance (e.g., Python, R) and guidance for data processing and analysis in tasks involving data analysis and modeling; (5) outlining background, procedures, and precautions prior to experiments to improve accuracy and efficiency in laboratory work. Our survey indicates that faculty and students at Henan Medical University are aware of and willing to leverage these advantages and features of ChatGPT to support teaching and are open to adopting this new AI tool.

Relying solely on instructors' explanations is far from sufficient for learning neuroscience; students' self-regulated learning (SRL) substantially enhances efficiency and ensures quality. ChatGPT not only supports instruction but can also foster the development of SRL skills. Information-integration technologies and SRL have been widely studied in online learning environments, with encouraging results [9]. With the rapid rise of

generative AI tools, researchers have recently proposed three instructional design principles—and accompanying guidelines—for AI chatbots to support SRL: goal setting, self-assessment with feedback, and personalization [10]. Although fewer than half of respondents (41.73%) believed that ChatGPT can assess students' learning progress and performance, its potential in this area is undeniable, chiefly in the following respects. (1) Personalized learning support [11]. By analyzing students' learning histories, behavioral data, and study habits, ChatGPT can provide individualized study recommendations and pathways. For complex neuroscience content, it can target weak points with additional practice and resources or recommend materials aligned with students' interests and pace. (2) Immediate feedback and assessment [8]. ChatGPT can grade assignments, quizzes, and exams in real time and offer detailed feedback or improvement suggestions, helping students identify errors and deficiencies for rapid improvement. (3) Learning-progress monitoring and prediction [12]. Through continuous monitoring of learning data, ChatGPT can evaluate progress, predict performance, identify bottlenecks and potential problems, analyze learning efficiency, assess mastery of specific knowledge points, and generate learning reports—assisting instructors in pinpointing issues and areas for improvement at the course level. That most surveyed faculty and students did not recognize ChatGPT's role in these aspects may stem from limited familiarity or under-utilization of its potential functions. This highlights the need to strengthen training and guidance when introducing ChatGPT into university teaching.

Although the rapid development of ChatGPT presents major opportunities for neuroscience education, its risks and challenges cannot be ignored. ChatGPT has sparked real-time, global debate over its transformative potential [13]. Most faculty and students at Henan Medical University recognize potential problems in applying ChatGPT to neuroscience teaching. A particularly important limitation is the high risk that ChatGPT may generate text that sounds plausible but is incorrect [14,15]. Educators and learners, therefore, need domain expertise and critical reflection skills to properly evaluate its outputs [16]. As a learning partner, ChatGPT may not inherently foster critical thinking; however, when used under instructor guidance, it can create opportunities to cultivate such skills. In addition, issues related to plagiarism and cheating, bias and fairness, privacy and security, and technological dependence may arise—indicating that, while adopting and using this transformative tool, both teachers and students should remain alert to its risks and take steps to mitigate them.

In sum, the generative AI tool ChatGPT is a promising catalyst for educational reform and has been widely recognized—and increasingly trialed in teaching and learning—by faculty and students in higher medical education. ChatGPT can assist instructors with course preparation and teaching, support students' self-directed learning and problem-solving, help assess learning progress and achievement, boost engagement, and provide personalized learning experiences, thereby creating new opportunities for neuroscience education. Nevertheless, its use entails risks and challenges related to information accuracy, academic integrity, and technological dependence. How best to leverage the educational opportunities brought by ChatGPT—and how best to mitigate its risks—constitutes an important interdisciplinary research agenda that warrants deeper exploration in the years ahead.

5. Outlook

The participants surveyed in this study were in-service faculty and enrolled graduate students from Henan Medical University, a university in China's central-western region. Although we prepared extensively for the analysis, the influence of geography and institutional tier cannot be denied. Some of the data presented here reflect only the attitudes and evaluations of Henan Medical University's faculty and students toward ChatGPT

and thus carry certain limitations. Nonetheless, our findings can still offer meaningful reference points for charting the future direction of ChatGPT in neuroscience education.

Looking ahead, as artificial intelligence continues to advance, the prospects for applying ChatGPT and other generative AI tools in education are broad. We recommend that educational institutions strengthen training for both instructors and students to help them better master the use of ChatGPT. Future research should focus on optimizing how ChatGPT is integrated into teaching so as to fully harness its educational potential while effectively mitigating its possible risks. By deeply exploring the synergies between generative AI tools and pedagogy, educators can create more efficient, interactive, and personalized learning experiences, thereby propelling neuroscience education to new heights.

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Disclosure statement

The authors declare no conflict of interest.

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