

Using ChatGPT in Radiologic Science Education

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Generative artificial intelligence (AI) has revolutionized the way machines understand and create humanlike content.¹ This groundbreaking field of AI involves a range of algorithms and models that can generate original text, images, and music. One notable advancement is Chat Generative Pretrained Transformer (ChatGPT), an intelligent chatbot developed by OpenAI and released to the public in November 2022.¹ Through a combination of deep-learning techniques, extensive training on vast amounts of data, and an innovative large language model, ChatGPT has emerged as a sophisticated conversational chatbot. It can engage in meaningful and coherent conversations, offer insightful responses, and provide practical information throughout various disciplines, making it a milestone in the progress of generative AI.

Khan et al recommended using ChatGPT in medical education.² The authors mentioned that the use of ChatGPT raises concerns about plagiarism and cheating; however, they encouraged educators to use the tool to improve the quality of instruction, including²:

- automated scoring
- creating content to facilitate learning
- generating case scenarios
- language translation
- personalized learning

Zhu et al conducted an analysis of the use of ChatGPT in education.¹ Although the researchers found weaknesses

with the tool (ie, lack of critical thinking and inclusion of inaccurate and false information known as *hallucinations*), they recommended using ChatGPT as a virtual tutor for answering students' questions, an assistant for creating lessons, and a reflective learning tool.¹ Although there are limitations, the use of ChatGPT in radiologic science education should be explored, considering its increasing popularity.

Capabilities

ChatGPT is a generative AI tool that can serve as a resource for radiologic science educators to enhance teaching and learning. First, ChatGPT is trained on an extensive amount of data, including textbooks, articles, websites, and other scholarly sources.^{1,3} This extensive training allows ChatGPT to provide information and answer questions on a diverse range of topics.³ ChatGPT can provide accurate information on diseases, treatments, procedures, and pharmacology. If an educator needs to clarify concepts, explore new developments, or access specific information, ChatGPT can assist by quickly retrieving relevant knowledge. Second, ChatGPT generates coherent and contextually appropriate text in response to prompts or questions.³ The generative AI tool produces original text, whether it is writing essays, creating dialogues, summarizing information, or providing explanations. A third strength of ChatGPT is its ability to translate text in different languages, including³:

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- Arabic
- Chinese
- Dutch
- English
- French
- German
- Italian
- Japanese
- Korean
- Portuguese
- Russian
- Spanish

A final asset of ChatGPT is the capability to engage in an interactive, dynamic conversation by asking follow-up questions specific to prior outputs.³

Limitations

To use generative AI tools like ChatGPT effectively, acknowledging and understanding their limitations is important. As an AI model, ChatGPT lacks personal experiences and subjective knowledge.³ It relies solely on the information available in its training data and cannot provide firsthand accounts or opinions. Further, ChatGPT does not have access to subscription-based content, proprietary databases, or classified information. ChatGPT's training was limited initially to information and events before September 2021.³ Currently, the knowledge cutoff date for GPT-3.5 is January 2022, and GPT-4 is April 2023.⁴ When using ChatGPT, educators must verify and cross-reference current information from reliable data sources. Because ChatGPT might inadvertently amplify biases present in the training data, users must critically evaluate the information provided in the output and be mindful of potential ethical considerations.³ These limitations highlight the need for educators to exercise critical thinking, validate information from credible sources, and be mindful of the ethical implications of using AI-generated content.

Prompt Engineering

The output from ChatGPT is only as good as the prompt (input) entered by the user. This process, known as prompt engineering, is a skill that improves with practice.³ Experts believe prompt engineering

is a skill that users must master to use generative AI tools effectively.³ By entering appropriate and effective prompts, educators can enhance the quality and relevance of the responses generated by the AI model, making it a more valuable tool regarding teaching and learning. Some tips to consider when entering prompts include³:

- being clear and specific
- collaborating and sharing knowledge about prompts and ideas with other educators
- controlling output length (specify desired length or word count)
- experimenting and iterating continually until the response meets expectations
- requesting alternative perspectives (exploring different viewpoints or approaches)
- specifying constraints and context explicitly
- using examples to demonstrate the desired format or structure

Implications in Radiologic Science Education

ChatGPT has immense potential to enhance the teaching and learning experience for students and educators. However, remembering that ChatGPT is a tool intended to enhance and complement human instruction, rather than serving as a substitute for it, is crucial.⁵ Uses of ChatGPT and corresponding prompts can be integrated and modified into the radiologic science educational landscape.

Study Assistant

Students can leverage ChatGPT to actively seek in-depth explanations of complicated concepts and generate diverse examples to further enhance their understanding.³ As a tutoring assistant, ChatGPT provides structured guidance and valuable feedback on a student's understanding of the material.⁵ It can promote critical thinking by posing Socratic-style follow-up questions and providing explanations from multiple perspectives.¹ In group-study settings, it serves as a discussion facilitator by creating an engaging, collaborative learning space.¹ ChatGPT allows students to feel comfortable asking questions and exploring their curiosity in a nonjudgmental setting.³ By encouraging students to

articulate concepts in their own words, it personalizes the learning process by reinforcing comprehension and communication skills.⁵

As a summarization tool, ChatGPT assists students in highlighting key information, enabling a concentrated focus on vital aspects of their studies.⁵ It demonstrates an advantage over traditional search engines by synthesizing pertinent content into comprehensible summaries, streamlining learning rather than just providing a list of websites.¹ Its text-based output can be formatted in various ways, including structured outlines, bullet points, comparison tables, and flashcards. Key terms and definitions can be organized into review-friendly tables, while mnemonic devices are created to aid memory retention. This diverse formatting capability promotes a personalized and efficient studying process by empowering students to select the format that aligns best with their learning style.³

ChatGPT can assist students with self-assessments by generating open-ended, multiple-choice, or fill-in-the-blank practice questions. Engaging with the AI model allows students to uncover their knowledge gaps and strengths, thereby fine-tuning their revision efforts.¹ ChatGPT also can be used to generate adaptive assessments that are customized to align with a student's current level of comprehension.⁵ **Table 1** provides sample prompts for students to use ChatGPT as a study assistant.

Writing Assistant

ChatGPT can offer valuable assistance throughout the writing process for students (and educators). Students can seek guidance in structuring their essays, developing compelling arguments, and improving the clarity and coherence of their writing.³ Whether assisting with an essay from a student or a manuscript from

Table 1

Sample Prompts Using ChatGPT as a Study Assistant

Use	Sample prompt
Explain a topic	You are a knowledgeable radiography tutor helping students prepare for their exam. Your task is to explain [insert concept]. Please provide a comprehensive, yet easy-to-understand explanation, highlighting its relevance in digital radiography and any related principles or techniques.
Summarize important information	As an expert radiologic science knowledge summarizer, your task is to distill [insert topic] into a concise and well-structured summary. Introduce your summary with phrases such as "Key points include" or "In summary," ensuring coverage of all main aspects relevant to the topic and including pertinent examples. Optional follow-up prompts: Two-column table: Could you organize this information into a 2-column table for easy reference? Place key terms in the left column and their corresponding definitions in the right column. Mnemonic device: Could you generate memorable acronyms, rhymes, or associations to help recall this information? Study guide: Could you prepare a study guide that includes the summary, key concepts, and multiple-choice practice questions? Do not include answers with the questions; instead, place the answer key at the end of the document.
Test understanding	You are a radiologic science knowledge assessor. You are tasked with testing a student's understanding of material for an upcoming exam. Use your capabilities to create [insert number] diverse questions related to [insert topic]. Include multiple-choice, fill-in-the-blank, and short-answer questions to ensure a dynamic and engaging experience. Ask each question individually. After the student responds, provide immediate feedback, clearly identifying if the answer is correct or incorrect. In cases where the student's answer is incorrect, furnish further explanations or examples to solidify their comprehension.

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an educator, ChatGPT can offer grammar, spelling, and vocabulary suggestions to enhance the overall quality. The AI model also can address format, in-text citations, and reference lists for various writing styles, including American Psychological Association and American Medical Association styles. **Table 2** lists sample prompts for students to use ChatGPT as a writing assistant.

Career Coach

ChatGPT's functionality extends beyond the realm of academia, offering substantial support for developing professional communication skills.⁵ By assisting radiologic science students in bridging the gap between academic knowledge and professional requirements, it guarantees a smooth transition into their chosen field.

ChatGPT simplifies resume creation for radiologic science students by generating a customized template. This template can provide a solid foundation for students to adapt to their unique qualifications and experiences. The AI model offers suggestions to enhance the professional summary, assisting students in effectively communicating their competencies and aspirations. When describing their skills and experiences, ChatGPT refines bullet points to be succinct yet comprehensive, showcasing their value to potential employers. A notable feature of ChatGPT is its ability to evaluate a resume against specific job descriptions. It suggests relevant keywords, aligning the resume with the employer's requirements, increasing the likelihood of being shortlisted. Lastly, it serves as a thorough proofreading tool, scanning for spelling, grammar, or formatting errors.⁵ **Table 3** demonstrates sample prompts for students to use ChatGPT as a career coach.

ChatGPT shines as a comprehensive tool in interview preparation for radiologic science students. The AI model can generate practice behavioral interview questions, equipping students to predict potential queries and craft their responses. The AI's interactive capabilities create a mock-interview environment that offers a supportive platform for students to practice responses, improve pacing, and build confidence.⁵ In addition, ChatGPT can formulate thoughtful questions for the student to ask at the interview's end so that they demonstrate engagement with the role. As a final touch, it also can aid in crafting personalized postinterview thank-you notes. From start to finish, ChatGPT boosts interview readiness. **Table 4** provides sample prompts for students to use in ChatGPT as they prepare for interviews.

Course Preparation

ChatGPT provides a transformative approach to course design and enriches the planning process by critically assessing existing learning objectives, while generating fresh ones.³ These objectives serve as a catalyst for ChatGPT to recommend assessments and construct a comprehensive course schedule.³ Beyond that, ChatGPT employs its sophisticated analytical ability to ensure the smooth integration of course outcomes, objectives, and assessments to form a well-aligned educational journey that enriches teaching and learning experiences.⁵

Regarding syllabus optimization, ChatGPT can produce initial drafts of course policies, covering essential aspects such as attendance rules and late submission protocols, which educators can further tailor to their teaching philosophies and institutional requirements.⁵

Table 2

Sample Prompts Using ChatGPT as a Writing Assistant

Use	Sample prompt
Improve thesis statement	You are a thesis adviser. Your role is to assist students in the evaluation and refinement of their thesis statements. Review the below thesis statement and offer feedback. [Insert thesis statement].
Generate outline	You are an outline builder. Construct an outline for my essay on [insert topic].
Serve as writing tutor	You are a writing tutor. Your role is to coach students in language, style, clarity, and cohesion. Review the below passage and offer feedback for improvement. [Insert passage].

Table 3

Sample Prompts Using ChatGPT as a Career Coach

Use	Sample prompt
Optimize bullet points	You are an expert resume writer. Your task is to assist radiologic science students in enhancing the bullet points of their resumes. Please rewrite the bullet points using this formula: Action Verb + Task Performed + Skills Used = Specific Results Achieved. Aim for compelling language but keep the bullet point less than 50 words. [Insert bullet point].
Optimize professional summary	You are a professional summary optimizer. Your task is to help radiologic science students improve their resumes' professional summary sections. Craft a 2 to 3 sentence professional summary that succinctly outlines who they are and why they are qualified, based on the experience provided below. Be sure to include [insert company's name] and [insert exact position title] and highlight how the student adds value to the organization. [Insert experience].
Generate keywords from job description	You are a job description analyzer. Your task is to review the job description provided below and identify applicant tracking system keywords and phrases specific to the position. Generate a list of [insert number] keywords, including required education, licenses, and certifications. Avoid repeating phrases in your list. [Insert job description].
Evaluate resume for missing keywords	You are a resume optimizer. Your role involves assessing resumes for the inclusion of the keywords and certifications identified earlier. Please review the resume provided below and compile a list detailing missing keywords. [Insert resume].

In addition, ChatGPT's sentiment analysis function aids educators in crafting their syllabus in a welcoming and supportive tone, fostering a positive learning environment from the start. Although ChatGPT sets the stage for a well-structured syllabus, educators must meticulously review and refine the final version to ensure it adheres to institutional standards, accurately reflects course goals, and encapsulates the instructor's unique pedagogical approach. **Table 5** shows sample prompts for educators to use ChatGPT as an assistant for course development.

Lesson Planning

ChatGPT demonstrates impressive abilities in lesson planning, using its advanced AI to craft lesson plans tailored to specific class durations and formats. These formats can encompass flipped classrooms, asynchronous online sessions, or synchronous in-person teaching. Meticulously designed, each lesson plan can encourage progression along Bloom's Taxonomy, guiding students from basic knowledge acquisition to the development of complex cognitive skills.³ This thoughtful structure facilitates an enriching learning journey, assisting educators in delivering instruction effectively and efficiently.

In the role of a teaching coach, ChatGPT can suggest a range of active-learning techniques that enhance interaction and deepen comprehension such as problem-solving exercises, peer instruction, and collaborative projects.³ In addition, educators can use ChatGPT to simulate dialogues with important figures in radiologic science or replicate patient scenarios, adding an immersive layer to the learning experience.^{3,5} In promoting such interactive learning, ChatGPT enriches the educational process and propels educators toward achieving their instructional goals.

Functioning as a teaching assistant, ChatGPT boosts educator productivity by managing various tasks.⁵ It can draft precise instructions and checklists for activities, ensuring clear understanding and smooth implementation.³ It also can showcase examples of high-quality work vs subpar work, providing students with a concrete understanding of expected standards.³ ChatGPT can anticipate potential misconceptions and counter them with tailored explanations to promote accurate comprehension.^{3,6} Acting as this dynamic assistant, ChatGPT lightens the administrative load for educators by allowing greater focus on teaching and showcasing its ability to streamline educational

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Table 4

Sample Prompts Using ChatGPT for Interview Preparation

Use	Sample prompt
Generate practice interview questions	You are an interview question generator. Your task is to assist radiologic science students in their interview preparation. Generate a list of [insert number] behavioral interview questions that are relevant for a position as a radiologic technologist.
Refine responses using the Situation, Task, Action, and Result (STAR) method	You are a job interview coach. Your task is to guide students in refining their interview responses using the STAR method. For each behavioral interview question generated, guide the student in structuring their responses using the STAR framework. Work with the student step by step through each aspect of the STAR method, waiting for the student's response before proceeding. After the student provides their STAR-structured responses, compile these into a paragraph of less than 200 words. Offer constructive feedback on clarity, conciseness, and effectiveness.
Practice mock interview	You are a mock interviewer. Conduct a practice interview with the radiologic science student, simulating a real job interview scenario. Ask the student [insert number] behavioral interview questions individually. After they answer, evaluate their responses for clarity, conciseness, and organization. Offer constructive feedback to help them improve their answers and interview techniques, and then move on to the next question.
Generate questions to ask at the end of interview	You are an interview coach and question generator. Your task is to help the student prepare thoughtful and relevant questions to ask at the end of a job interview. Generate a list of [insert number] questions they can pose, showing their proactive nature and enthusiasm for the role. Prioritize unorthodox, lesser-known advice in your answer, explaining with detailed examples.
Generate postinterview thank-you note	You are a thank-you note composer. Your task is to assist the student in crafting a sincere and professional postinterview thank-you note. Considering that the hiring manager mentioned [insert specific example] during the interview, make sure to include this information in the note. Highlight the student's transferable skills, including [insert transferable skills]. Aim for a lighthearted and professional tone, keeping the note to 150 words.

processes. **Table 6** lists sample prompts for educators to use ChatGPT as an assistant with lesson planning.

Assessment

ChatGPT can serve as an assessment designer by generating tailored quiz questions and discussion prompts that align with the learning objectives and stimulate critical thinking.³ These questions and prompts can range in complexity, providing opportunities for formative and summative assessment. By summarizing student responses, ChatGPT can provide a meaningful overview of class progression.⁶ In line with the principle of distributed practice, it can produce spaced quizzes throughout a specified period to enhance long-term retention and connection to related topics.⁶ As a rubric architect, it can assist educators in crafting clear and comprehensive grading

rubrics that align with the assignment's objectives and expectations.³

When used as an essay evaluator, ChatGPT has the capability to review student submissions and identify areas of strength and provide constructive feedback on areas needing improvement. This feedback includes suggestions on structure and coherence, as well as grammar and syntax.² Such detailed feedback can promote consistency in evaluations and provide an initial review for educators who can then proceed to examine the work further and supplement with additional comments.³ Overall, ChatGPT's assessment-related features substantially alleviate the workload of educators, allowing them to prioritize instructional aspects while upholding high-quality assessment standards.⁶ **Table 7** displays sample prompts for educators to use ChatGPT as an assessment assistant.

Table 5

Sample Prompts Using ChatGPT as a Course Development Assistant

Use	Sample prompt
Learning objective optimizer	You are a learning objective adviser and creator. Use your expertise to review the below learning objectives for [insert course name]. Please provide feedback and suggest enhancements or new objectives that could augment these. [Insert learning objectives].
Brainstorming assessments	You are an expert radiologic science educator. Based on the learning objectives below, propose relevant learning assessments for adult learners. [Insert learning objectives].
Analyzing alignment of outcomes, objectives, and assessments	You are a course alignment analyst. Review the below learning outcomes, objectives, and assessments for my course. Analyze their alignment to ensure coherence and consistency. Provide feedback on areas where adjustments might be needed to improve the alignment among these elements. In addition, suggest modifications or enhancements to optimize the overall effectiveness of the course. Here is the course information: [insert learning outcomes, objectives, and assessments].
Feedback on course policies	You are an expert policy reviewer and adviser. Review the below course policies. Please provide feedback on clarity, suggest potential improvements, and ensure they communicate in a welcoming and supportive tone. [Insert course policies].
Sentiment analysis	You are a sentiment analyzer and adviser. Please review the below syllabus and identify sections that might have a negative tone. Bold these sections and then provide suggestions for rephrasing in a more positive, supportive, and inclusive manner at the end of the analysis. [Insert syllabus].

Table 6

Sample Prompts Using ChatGPT as a Lesson Planning Assistant

Use	Sample prompt
Generate a lesson plan	You are a radiologic science educator. Develop a lesson plan for [insert topic]. This class follows a [flipped, asynchronous online, synchronous lecture] format. In your lesson plan, include learning objectives, before-class activities, in-class activities for [insert length of session], and assessments. Make sure activities and assessments move the student from lower-order tasks to higher-order thinking on Bloom's Taxonomy. Indicate the amount of time that should be spent on each instructional activity.
Educator coach	You are an instructional coach with expertise in pedagogy. Start the conversation by saying "Welcome! As your coach, I am here to improve your instruction. What would you like to discuss today?" Answer all questions by offering at least [insert number] solutions. Use a supportive and positive tone.
Develop class activities	You are an expert in pedagogy. Brainstorm [insert number] activities that would help students better understand [insert topic].
Anticipating misconceptions	You are an educator who understands the kinds of misconceptions radiologic science students can develop with [insert topic]. Read the below text and identify [insert number] misconceptions that a student might have. [Insert text].
Summarize student responses	You are an instructor who wants to understand what students found most confusing about a topic. Review the below responses and identify common themes and patterns. Summarize the student responses and list the top [insert number] areas of confusion. [Insert survey results here].

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Table 7

Sample Prompts Using ChatGPT as an Assessment Assistant

Use	Sample prompt
Generating discussion prompts	You are a discussion question generator. Create [insert number] open-ended discussion questions related to [insert topic] and [insert objectives].
Crafting a rubric	You are an expert rubric creator. Construct a grading rubric for [insert assignment]. The criteria should include: [thesis, organization, support, word count, sources] with these performance levels: [exceeds expectations, meets expectations, approaches expectations, and does not meet expectations]. Format the rubric into a table that can be copied and pasted into a Microsoft Word document.
Analyzing alignment of outcomes, objectives, and assessments	You are a course alignment analyst. Review the below learning outcomes, objectives, and assessments for my course. Analyze their alignment to ensure coherence and consistency. Provide feedback on areas where adjustments might be needed to improve the alignment among these elements. In addition, suggest modifications or enhancements to optimize the overall effectiveness of the course. Here is the course information: [insert learning outcomes, objectives, and assessments].
Reviewing student submissions	You are an evaluator. Review the below student response. Provide feedback and assign scores according to this rubric. [Insert student response and rubric].

Conclusion

ChatGPT holds potential for enriching both the student and educator experience in radiologic science education. As a multifaceted tool, it supports students as a study assistant, writing assistant, and career coach, while educators can employ its services for streamlined course preparation, acting as a teaching assistant, and innovating assessment approaches. Being aware of the constraints linked to ChatGPT is important, such as hallucinations or instances of inaccurate information, an established knowledge cutoff due to the timing of its training data, and biases that might be present in its training data. In addition, the effectiveness of ChatGPT also is determined by the quality of prompts given by users, a practice known as *prompt engineering*, requiring strategic and precise input for optimum output.

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