



JOURNAL

OF THE

EUROPEAN HONORS COUNCIL

Note

Breaking Boundaries with Generative AI: Good Practice of Unleashing the Power of ChatGPT for Inter- and Transdisciplinary Breakthroughs in the Age of Complexity

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Received: March 17th 2023; Accepted: June 23rd 2023; Published: June 29th 2023

Keywords: ChatGPT; Generative AI; Interdisciplinary Education

“In the light of day, I know that Sydney is not sentient [but] for a few hours Tuesday night, I felt a strange new emotion – a foreboding feeling that AI had crossed a threshold, and that the world would never be the same.” – Kevin Roose, The New York Times

1. Introduction

The major issues we confront today, such as poverty and inequality, the global health crisis, political extremism, and climate change, are complicated and multifaceted. We must implement novel tactics that draw on interdisciplinary and transdisciplinary approaches to handle these problems successfully. The inter- and transdisciplinary methods give us the ability to combine ideas, techniques, and information from different disciplines, leading to a more comprehensive understanding of the issues at hand.

Interdisciplinary approaches, which combine theories, concepts, and methodologies from various fields result in helpful new conceptual frameworks, blending ideas from different fields. The goal of transdisciplinary approaches, on the other hand, is to develop new holistic solutions by dissolving disciplinary boundaries and fostering of co-creation of knowledge, going beyond the simple combining of fields.

The next generation of complex problem solvers that engage in inter- and transdisciplinary inquiries is fostered in higher education using talent or honors programs. These programs

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aim to recognize and assist gifted students in accelerating their development to realize their full potential. Talent programs create an excellent setting for students to engage with complicated challenges and develop the art of interdisciplinary and transdisciplinary problem-solving by offering tools, mentorship, and opportunity for cooperation in teams, and across disciplines.

The critical thinking, creativity, and effective communication skills that students can develop in these talent programs are crucial for overcoming complex problems. Students receive practical experience negotiating the complexity of inter- and transdisciplinary problem-solving by working on real-world projects and interacting with peers and professionals from a variety of professions.

Additionally, talent or honors programs often serve as the experimental laboratories for education, where new pedagogical approaches are developed and tested, thus making it uniquely fit for the implementation of new technologies, such as ChatGPT and other Generative AI tools, that can assist with inter- and transdisciplinary problem solving.

2. ChatGPT and Generative AI Tools

On November 30, 2022, the introduction of the ChatGPT (Generative Pre-trained Transformer) AI platform suddenly made our world more complex, creating vast opportunities and challenges (Larsen & Narayan, 2023), including opportunities and challenges for how we implement honors education. ChatGPT is a state-of-the-art large language model developed by OpenAI, which predicts which words are likely to go together in response to a prompt. The technology gained one million users in five days since its introduction (Bucholtz, 2023) and 100 million users worldwide in just two months (Paris, 2023), making it the most popular web application in Internet's history. With the technology recently passing medical, law, and graduate business exams (Wilde, 2023), the tool has created a fury of interest among educators and students alike as to how it can be best used to increase the productivity and effectiveness of teaching and learning. In less than two months since its launch, Forbes (2023) reported a 90% student awareness and 82% faculty awareness of the platform on college campuses in the United States. However, ChatGPT is just one of over five thousand generative AI tools currently available on the market (There Is AI for That, n.d.) and more tools are becoming available daily. ChatGPT is just the tip of the iceberg.

Generative AI tools can create text, code, images, audio, music, or video using deep learning algorithms, reflecting humanity's language, writing, literature, code, and art. They can perform tasks that were once thought to be exclusively the domain of humans, such as writing essays, reports, or poems, building programming applications, composing music, generating visual artwork, or creating hosted shows on the radio (Papadopoulos, 2023). In the field of education, these tools have already been used for a variety of purposes (Liu, 2023; McMurtrie, 2023; Mollic & Mollic, 2023; Ofgang, 2023), including creating course syllabi, providing feedback to students, conducting research, and creating different forms of assessment. But the possible impact of generative AI in the field of honors education goes

far beyond these applications, potentially helping to create breakthroughs as honors students tackle complex problems facing our world today.

To date, a good portion of the conversation in the academy about generative AI has focused on how “ChatGPT robs students of motivation to write and think for themselves” (e.g., Baron, 2023), and called for the return of pen-and-paper or oral exams (e.g., Cassidy, 2023) to avoid plagiarism and cheating (Westfall, 2023). The early focus on student cheating and ways to combat the cheating has been misplaced, though certainly understood. Suddenly, tools have become available to students that have allowed them to respond to assignments with content generated by technology in a manner of minutes. The problem in this scenario is not with the student's use of the technology but with the faculty's lack of adaptation to the new reality, which of course will take time. We should educate the students about proper and improper technology use in our courses, motivate them to use it properly, and ultimately, revise our assignments, elevating the challenges presented, rather than try to police the students using AI cheating detection software. The AI plagiarism detection software is far from accurate themselves, especially considering the existence of cheating evasion tools (Volante et al., 2023), such as QuillBot, which is already available as an extension in MS Word.

Recently, the conversations around generative AI in higher education have begun to shift away from avoiding cheating, towards ways of embracing it in an ethical way to help us be more productive, “expand our intellectual discourse and boost research” (Rockwell, 2023). To that end, some universities have proposed models of how to respond to ChatGPT and generative AI tools by offering general guidance for faculty (e.g., Montclair State University, n.d.), faculty resources (e.g., San Francisco Community College Library, n.d.; The University of Sydney, n.d.), or proposed implementation frameworks (e.g., Taylor, 2022; The Sentient Syllabus Project, 2023) or simply explored opportunities for application of Large language Models (Kasneci et al., 2023). Higher education is slowly acknowledging that we are at an inflection point rather than a crisis (Pearce, 2023). With the use of these tools in the professions everywhere (Mack, 2023), prominent university professors believe that the future belongs to those who can master working collaboratively with generative AI (Darics & van Poppel, 2023; David, 2023; Warzel, 2023). We have entered a new era of human-machine collaboration. Understanding the technology affordances and limitations is therefore critical to enable us to rethink what we do in our honors programs and consequently, elevate the caliber of our teaching and learning, to include inter- and transdisciplinary problem-solving.

3. ChatGPT Capabilities for Inter- and Transdisciplinary Breakthroughs

ChatGPT can assist our talented students in addressing complex problems that require interdisciplinary or transdisciplinary approaches in several ways (Lonas, 2023). Below is a discussion of potential technology applications to help with inter- and transdisciplinary breakthroughs.

By granting real-time access to an extensive range of knowledge from diverse academic disciplines, students can explore, comprehend, and appreciate a wide variety of disciplinary perspectives. ChatGPT can skillfully synthesize information from these different fields,

breaking down complex ideas and concepts into accessible, easily digestible explanations and summaries, allowing students to just-in-time build a solid foundation of understanding.

During brainstorming sessions, ChatGPT can serve as a valuable collaborator, guiding students in investigating numerous viewpoints and formulating innovative solutions that span disciplines. It fosters a creative and open-minded atmosphere that encourages students to think outside the box and challenge conventional wisdom. This human-technology collaborative environment not only helps students generate fresh ideas but also promotes a deeper appreciation for the interconnectedness of various academic fields.

Effective communication is essential in interdisciplinary and transdisciplinary work, as students must be able to convey their ideas and perspectives to others who may have different backgrounds and areas of expertise. ChatGPT could play a crucial role in enhancing communication by helping students articulate their thoughts more clearly and coherently, helping ensure mutual understanding among team members. It also provides expert-level assistance with syntax and grammar, helping students present their ideas professionally and confidently.

In addition to fostering collaboration and communication, ChatGPT can also serve as an analytical tool that dissects the problem at hand and suggests relevant interdisciplinary connections. By identifying potential linkages between disciplines or areas that could benefit from further research, ChatGPT prompts students to explore new research questions and expand their understanding of the problem. This comprehensive analysis not only deepens students' knowledge but also enables them to develop innovative and integrative solutions.

ChatGPT can empower students to evaluate the advantages and disadvantages of various approaches they may encounter in their interdisciplinary or transdisciplinary work. Students can use ChatGPT to pinpoint knowledge gaps and receive guidance on how to fill those gaps through subsequent inquiries. This iterative process allows students to refine their understanding and develop a more robust, well-rounded solution.

Additionally, by assisting students in evaluating their approaches to problem-solving and seeing chances to broaden their research, ChatGPT can motivate them to consider their multidisciplinary and transdisciplinary methodology. Students can gain knowledge from their experiences, modify their approaches, and continuously develop their interdisciplinary and transdisciplinary problem-solving abilities by participating in this reflective activity.

ChatGPT can play a critical role in assisting students in successfully navigating complicated issues that call for interdisciplinary or transdisciplinary approaches by providing these numerous opportunities to be used. The AI tool assists students not only in their academic achievements but also in the development of crucial abilities like human-technology teamwork, creativity, communication, and critical thinking.

In summary, ChatGPT serves as an invaluable resource for students working on complex problems by providing multifaceted support in understanding, analyzing, and solving interdisciplinary and transdisciplinary challenges. Its ability to synthesize information from multiple fields, facilitate brainstorming sessions, enhance communication, suggest relevant

connections, support critical thinking, and encourage reflection allows students to develop a strong foundation for tackling the intricate challenges of our contemporary world. By leveraging ChatGPT's capabilities, students can become well-rounded problem solvers and innovative thinkers, ready to make a positive impact on the world.

4. ChatGPT Limitations

Any new technology adopters need to understand its limitations so they can appreciate the tool's capabilities and make informed decisions about how it can be best used. One of the biggest limitations of ChatGPT is its lack of contextual understanding. It can generate human-like responses to text inputs, but it cannot truly understand the context of a situation or conversation. It does not understand the world, past experiences, emotions, or personal motivations, which are crucial for truly understanding student needs. Since "its underlying algorithms don't draw directly from a database of facts or links but instead generate strings of words aimed to statistically resemble those seen in its training data, without regard for the truth," (Knight, 2023) use of ChatGPT can sometimes lead to incorrect responses, endearingly called "hallucinations." Recently introduced ChatGPT4 has significantly reduced these hallucinations and consecutive versions of the technology will improve its reliability with each iteration.

While ChatGPT has been trained on a vast amount of text data, using 175 billion data points (Marr, 2023), it does not have the same level of expertise in every field. This means that its responses in certain areas, such as complex scientific or mathematical concepts, may not always be accurate or precise. Furthermore, ChatGPT may not have a deep understanding of the nuances and complexities of various academic disciplines, which can lead to inaccurate responses, especially in academic contexts that rely on non-textual information. With the introduction of ChatGPT4, we can observe a greater accuracy in advanced reasoning and complex problem-solving.

The performance of ChatGPT is directly linked to the quality and diversity of the data it was trained on, which means that its limitations and inaccuracies may be perpetuated. This is particularly significant in higher education, where students and educators rely on accurate and up-to-date information to support their learning and research. Currently, ChatGPT has only been trained on data through 2021, though one can install the WebChatGPT extension to get access to the most up-to-date information within the platform. The industry is working on developing solutions to mitigate this critical issue and now other platforms, such as e.g., Microsoft Bing search engine, offer access to GPT-4 and web search in one platform.

ChatGPT has a potential for racial, ethnic, gender, and linguistic bias and discrimination, which is a common issue in all AI systems that rely on the text data they were trained on. If left unaddressed, ChatGPT may perpetuate biases and discriminatory language present in the training data. This is an issue that is not going to be easy to overcome, except with more training and more data points in the subsequent versions of the technology and there is already work underway (Mitchell, 2023).

From the user perspective, there are also several additional drawbacks that could be encountered: e.g., privacy concerns and potential for overreliance on technology. User interactions with the generative AI platform could be tracked, leading to profiling and privacy violations. There is also the risk that students will over-rely on AI tools and not develop their own critical thinking, problem-solving, or research skills. It is important that learners use generative AI tools as aids rather than replacements for their work.

While ChatGPT has many limitations, downplaying its potential would be a mistake. ChatGPT is not a substitute for human interaction and should not be used as the sole means of support for students. Instead, it should be used in conjunction with other resources, such as human teachers, advisors, and readings to provide students with the comprehensive support they need for academic and professional success. Understanding the capabilities and limitations of this new technology naturally leads us to wonder how we could implement the tool in our courses and programs.

5. Helpful Frameworks for Implementing ChatGPT in Coursework

There are several instructional design frameworks that educators could use to effectively integrate ChatGPT into their teaching practice. ADDIE model (Molenda, 2003), Merrill's Principles of Instruction (Merrill, 2002), and Bloom's Taxonomy (Anderson, et al., 2001) are three helpful frameworks when considering implementing ChatGPT and other generative AI tools in the classroom.

The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model suggests that implementing ChatGPT should start with analysis, learning first about ChatGPT's capabilities and limitations and analyzing its applicability throughout the course. Once you have analyzed the potential applicability of the chatbot within your course, identify several tasks where you and the students could benefit from the technology throughout the course. This may include creating a detailed plan for the ChatGPT implementation process. Once you design the detailed plan, begin developing prompts and questions for the chatbot, creating the learning activities that integrate ChatGPT, and developing training materials if needed. Once you have a detailed plan, begin implementing it by integrating ChatGPT into your day-to-day teaching and learning environment, adjusting as needed, based on the feedback received in class. Finally, evaluate the effectiveness of the implementation by assessing student learning outcomes and gathering feedback from them to refine your approach in the next iteration. ADDIE model is relevant in a situation when one can dedicate time to intentionally incorporate the new technology throughout the course, while Merrill's Principles of Instruction allow educators to immediately jump into experimenting with the technology.

Merrill's Principles of Instruction (Activation, Demonstration, Application, Integration) is a framework that emphasizes the importance of engaging learners, promoting active participation, and deep learning, critical for complex problems. For example, faculty can start implementing ChatGPT by having students ask questions on the platform related to the content they will be learning and encouraging them to explore related topics. Another way to use ChatGPT in the classroom is to demonstrate key concepts and provide examples of

the technology use. ChatGPT can also be used to promote concept application and practice. For instance, it can provide feedback and support as students work through problems or provide personalized guidance as they practice new skills. Lastly, ChatGPT can be used to help students integrate their learning into real-world contexts. This may include facilitating collaborative problem-solving activities on real-world problems or encouraging students to explore how the content can be applied in different contexts.

Bloom's Taxonomy (Remembering, Understanding, Applying, Analyzing, Evaluating, Creating) is a hierarchical framework that classifies educational learning objectives into six different levels of cognitive complexity and has become a widely used tool in education since the 1950s. Each level represents a different type of cognitive activity that can be used to demonstrate learning. For example, based on faculty's different learning objectives that often map to Bloom's verbs, faculty can plan to incorporate the ChatGPT accordingly. To help with remembering, ChatGPT can be used to aid in memorization and recall of facts. For instance, a student could use the AI to review definitions, historical dates, or mathematical formulas. A student might ask, "What is the definition of quantum mechanics?" or "When did the French Revolution start?" To help with understanding, ChatGPT can help explain complex topics in a simpler way or provide additional context to understand a particular concept. A student might ask, "Can you explain the Theory of Relativity in simple terms?" or "Can you provide an example of how supply and demand work in economics?" To develop a better ability to apply newly learned material, AI can assist in demonstrating how a concept is used in a practical context, aiding the students in their application of knowledge. A student might ask, "How would I use the Pythagorean theorem to calculate the length of the third side of a triangle?" To help develop the ability to analyze ideas, students can use ChatGPT to break down complex topics into smaller parts for better understanding, identify relationships, or examine potential outcomes based on a set of circumstances. For example, a student might ask, "What were the main causes of World War II?" or "How does climate change affect ecosystems?" To assist with the evaluation of ideas, ChatGPT can provide facts and data for students to base their judgments upon. For example, a student could ask, "What are the arguments for and against genetic modification in agriculture?" or "Can you list the pros and cons of renewable energy sources?" And finally, to assist with the creative process, ChatGPT can serve as a tool to aid in brainstorming and the generation of new ideas. For example, a student could ask, "What are some potential topics for a research paper on climate change?" or "Can you help me generate an outline for a persuasive essay on the ethical implications of AI?"

By using ChatGPT in these ways, educators can create a structured approach to integrating technology immediately into their teaching practice and ensure that the tool is being used effectively. Ultimately, that will lead to enhanced student learning outcomes, promoting engagement, active participation, and deep learning, typical of honors learning environments that tackle complex problems facing our world today.

6. Conclusions

Talent or honors programs often serve as experimental laboratories for education, where new pedagogical approaches are developed and tested. Additionally, interdisciplinary, and transdisciplinary techniques are incorporated into talent programs to better prepare

students for taking on today's major concerns. These programs produce a generation of creative thinkers who are prepared to address the complex problems facing our world by establishing a learning environment that promotes the bridging of knowledge areas and the development of adaptable problem-solving skills.

ChatGPT and generative AI tools are bigger than the introduction of the Internet, the Netscape browser, iPhone, or social media, with the potential to accelerate changes in our lives at an unprecedented rate. The implementation of ChatGPT and generative AI tools in talent programs can transform the way students learn and teachers teach, bringing assistance to breaking complex tasks apart and efficiently developing transdisciplinary solutions.

To maximize the benefits of ChatGPT and ensure that it is used ethically and responsibly, it is crucial to have a clear understanding of its applicability and limitations. This can be achieved by establishing and sharing guidelines that clearly outline the acceptable uses of the technology in our courses, disseminating timely information about the technology's applicability in different contexts, and assisting faculty to implement the technology. The faculty may need awareness seminars for inspiration, workshops to learn prompt engineering, and a community where they can share their experiences and questions.

The argument over how technology will impact society has heated up with the rise of artificial intelligence, propelling the use of ChatGPT and other generative AI tools to the forefront of our discussions in the academy and the media (*Artificial Intelligence: Last Week Tonight with John Oliver*, 2023). We have a responsibility in higher education to learn and take advantage of the generative AI tools' full potential, bringing about a revolution in the way students learn, teachers teach, and honors-type of education can bring solutions to complex, real-world problems we face every day. Our honors program graduates play important roles in shaping the world we live in, and we owe it to them to prepare them for a world where they will work collaboratively with AI, where the ability to do so will make them more competitive. AI has crossed the threshold and the world will never be the same. Now is the time for us to act. Our students will use the technology whether we know it or not. Perhaps we should tap them to help us figure out jointly the path ahead.

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