Embracing Generative AI Tools for Capstone

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Michael Heroux
Scientist in Residence
Department of Computer Science
College of Saint Benedict & Saint John's University

This semester I integrated generative artificial intelligence (AI) tools into the capstone course for Computer Science students. I encouraged my students to experiment with tools such as ChatGPT and GitHub Copilot and I shared my own experiments and results with my students. My expectations were that students use the tools as part of becoming experts in their chosen topic, that they find and cite original sources for the content they used, and that they acknowledge and describe how they used the generative AI tools to assist them in their research, writing, and presenting.

In addition to setting these expectations, I also changed my assessment strategy to determine their levels of expertise. While I still required well-written and complete papers, and good presentations, my assessment of a student's level of expertise was based on my interactions with them in individual discussions and, most importantly, an extended question-and-answer session as part of their in-class presentations.

Finally, I introduced more iteration and incrementation into the assignment delivery schedule. The computer science capstone course has always used an incremental approach to developing sections of content that are eventually synthesized into a final comprehensive paper and presentation. However, this semester I also required students to submit a draft of each section several days before the official due date, regardless of the state of the draft content.

From these experiences, I took away the following observations:

1. **Assessing level of expertise via dialogue (Q&A) promotes the use of generative AI tools to improve student understanding.** As we progressed through the semester, some students did not demonstrate a deep understanding of their research topic, but the majority did. Most students reported that the use of generative AI tools accelerated their ability to identify and understand content related to their topics. I did not observe wide-spread use of plagiarized or automatically generated content and most students demonstrated a level of understanding that matched the content of their papers and presentations. One potential risk of relying so heavily on Q&A is that some students are not always able to demonstrate their knowledge fully through this approach. I believe the multiple opportunities during the semester for Q&A made it less likely that a student would be unfairly assessed but it is still a concern for the future.
2. **Increasing the frequency of draft submissions appears to reduce incentives to submit content that students do not understand well.** Comparing final papers to drafts submitted several days earlier showed that students had made good progress with their drafts and had made further progress before submitting their final paper. While generative AI tools were being used as part of the writing process, student reported

using the tools to help brainstorm content and improve grammar and spelling, not write entire paragraphs just prior to submitting their papers.

3. **Student ability to determine the topic and scope of their research improved substantially.** Most students were able to use generative AI tools as brainstorming and research companions. Through dialogue with an AI tool, they could rapidly explore new topics, find one that interested them, and define a scope that was achievable in a semester-long course.
4. **Students submitted papers with near-perfect grammar and spelling.** Unlike past years, there were almost no grammar and spelling errors in written assignments. Sentence and paragraph structure were generally improved. Assessing basic writing skills became effectively irrelevant, regardless of a student's innate writing skills. While advanced grammar and spelling tools, e.g., Grammarly, can provide a similar outcome, the use of generative AI tools resulted in nearly perfect prose from the perspective of mechanics. However, compactness of text and other desirable features of high-quality technical writing were not guaranteed nor was the overall ability of the reader to understand the content.
5. **Students who did not acquire a deep level of expertise as evidenced by Q&A assessment wrote papers that were technically correct but very hard to read.** Perhaps this observation should not be surprising, but I found it very interesting. One quote that speaks to this connection is Stephen Wolfram's 0-th law of technical writing, "If you don't understand what you are writing about, your readers don't stand a chance."
6. **Students who used generative AI tools effectively were able to learn and produce more about their topic, more quickly, and with less effort than before these tools were available.** When used appropriately, my experience with my students this semester was that generative AI tools were effective tutors, writing companions, editors, and more. Students who focused on pursuing the objectives of the course—building expertise in a research topic, writing effectively and efficiently about the topic, and presenting their ideas to an audience—were greatly aided by these tools. The net results of using generative AI tools were better papers and student understanding of content, produced faster, and with less effort.

Future plans

I plan to continue exploration of generative AI tool usage with my capstone students. We will explore the use of methodical approaches that support the research lifecycle and improve the quality of papers and presentations. I will emphasize the connection between building expertise and producing content that your audience can understand.

I plan to adjust the deadline for students' final papers and presentations so we will be done several weeks earlier than in past years, since generative AI tools can make this possible. With the extra weeks, I intend to spend more time discussing with students the importance of aligning technology with human needs. I believe students will find technology alignment interesting. Furthermore, using the extra class time that the productivity gains of generative AI provide—instead of making the course assignments more challenging—signals to the

students that we can use productivity increases to improve the quality of our lives rather than taking on more ambitious projects.

Final thoughts

Generative AI tools are a disruptive presence in society. If properly integrated, I think these tools can significantly decrease the mechanical cost of generating many kinds of content: text, images, computer code, and more, while still preserving the integrity of what is produced. Since these mechanical costs are lower, the remaining human work of creative endeavors is increasingly focused on *what* we want to create and *how* it is designed. To me, this means that future successful creators will be people who are good at deciding what people need and want and how to create it, people who best understand the human person and our society. In other words, success tilts in favor of people who are well educated in the liberal arts, our students.

Note: No generative AI tools were used to produce this document :-)