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May 31, 2026 - August 7, 2026

Organic Chemistry and AI Final Report

When I set out to complete this experiment, I had two main goals: one, to test AI's teaching capabilities and explore how it might replace or change existing educational models; and two, to learn organic chemistry at the college level. The idea of doing this experiment originated when Professor Bortnik reached out to me and offered me the opportunity to work with him on a summer project. I gladly accepted, and while brainstorming about the project, he brought up that the explosion of AI was such a new occurrence that there had hardly been any practical research done on it. I liked the idea of exploring this new opportunity, but I also wanted to combine it with my own interests. At first, I had wanted to conduct scientific research, but Prof. Bortnik's suggestion led to a new idea: combining science and AI to explore what might be possible. Because I had lots of past experience using AI to learn, taking it to an extreme sounded both doable and exciting. Therefore, I decided to use AI to teach myself college-level organic chemistry, a notoriously difficult branch of chemistry that would challenge both me and the AI.

I was apprehensive about starting this journey. Having used AI to aid me in my previous chemistry courses, I knew that it had excellent teaching potential but was also aware of how frustrating it could be. I was particularly familiar with ChatGPT. Because it is infamous for its sycophantic habits and how easily it can be manipulated, I originally wanted to use a different AI model for the experiment. Prof. Bortnik left the decision to me but suggested that I use ChatGPT because it is the most available and widely used of all the AI models in America. In order for the research to be useful, I needed to make sure that it would be replicable and that its applications

could spread to many people. Therefore, I opted for ChatGPT. Before the first day, I found a syllabus online for an MIT organic chemistry course. I also found practice exams and a textbook to keep me on track. I planned to write a diary entry every single day to show my mental and emotional states throughout the experiment. I created a project folder and had a long conversation with the AI about what the project would be, how I wanted it to behave, and what the goals of the experiment were. Even just this conversation helped me learn about how to treat the AI. I needed to be firm in order to get it to act how I wanted. I also had to tell it everything about the project, down to the last little detail. Once the AI showed that it understood the plan, I was able to start.

Overall, I had very mixed feelings about my actual experience. I am glad that I got to learn college level organic chemistry for free and in a short amount of time, but it did get quite exhausting towards the end. Starting off, I was very optimistic and excited, and for good reason. The AI began as a strong teacher with good pacing and explanations. As we dove into the harder topics, I started to feel frustrated more often. A lot of times, the AI asked me to review questions that just repeated themselves and did not progress our lesson. Other times I got asked questions with very specific answers that the AI had not introduced to me before. However, I appreciated the AI's patience with my questions and lack of understanding. For example, throughout week 4 I struggled with the concept of hyperconjugation. The AI was able to explain it every single time I asked without getting frustrated and instead expressed what felt like empathy towards me. This not only helped me learn, but it also eased my own frustration with the course material. In experiences like this the AI did feel almost humanlike.

Beyond the AI, the learning experience was vastly different from that of a regular high school class. Despite how simple some of these distinctions may sound, I have noticed that they

all add up in meaningful ways. There were many positives. The class was tailored for me, so I could move past easy topics and spend more time on ideas I did not understand. Instead of getting distracted by tablemates or interrupted by announcements, I could do my work undisturbed. My work was portable, so I could do it anywhere, from my own home to a coffee shop to a library. I could take breaks whenever I wanted, do my lessons at whatever time, and skip a day and make up for it later if necessary. Despite having to go out of town multiple different times, I was still able to undertake and complete the project, something that would not have happened if the project had less flexibility or if it was organized at a school. This independence was far different from the strict, suffocating rules and schedules that school imposes on its students. However, there needs to be a balance between liberty and responsibility. Some downsides of the nature of the experiment are that I actually had too much liberty. Every once in a while, I would get extremely unmotivated and procrastinate the day's lesson for as long as possible. I would get lazy and put in a half-hearted performance even though I truly did care about the topics we were covering. Some of it was just fatigue, but a large part of it was the fact that there was no strict timetable for me to follow. Additionally, the AI could not and would not reprimand me for being lazy or for doing the lesson late, because it either could not tell or did not care. At times it was a little too easy to get distracted by life and forget about the project. Overall, the freedom of AI-based learning was one of its greatest advantages, but it also revealed how much traditional education depends on external structure and accountability.

Although the structure of the experiment affected my experience, the more important question was whether the AI itself could actually teach effectively. To be fair, there are a few disclaimers that need to be made. Organic chemistry is a particularly tough subject to be taught online because of how visual of a science chemistry is. Bicyclic compounds, chair

conformations, and even simple Lewis structures are all much better understood when seen in different angles and dimensions, something that ChatGPT has trouble showing. Additionally, a teacher can only do well if the student is a good one. Though I think that I did a good job, I was not perfect. I occasionally lost my temper or got lazy, potentially limiting the AI's ability to teach.

One benefit the AI brings over a regular teacher is patience and humility. Real teachers do not always have the time or patience to put up with students and be constantly available. AI's personality can quickly match yours and it easily resolves conflicts by explaining its thinking clearly and being humble and honest. This widely differs from high school and college professors who are not always willing to back down or work things out. Additionally, AI is very good at quickly adapting to change. If I felt that a lesson was not helpful, I could tell the AI and it could instantly readjust. Teachers have an entire class to placate to and are not able to instantly plan entire lessons. Furthermore, AI is very widely accessible and can be used at any time, whereas teachers have lives outside of work and multiple other students that also require their attention. With AI, there is near-zero delay between confusion and help, so learning happens quickly and continuously. Additionally, the AI has a nearly endless capacity for creating practice problems and giving individualized feedback. Real teachers would not have the time or bandwidth to do so. However, AI is far from perfect. In fact, despite all of these benefits, the experiment has proven to me that AI will never be able to replace full-time teachers and professors no matter how much its software improves.

The example that best shows the duality of working with an AI is the creation of the final exam. When I first told it we would start creating the final, it told me "And before we start, I want to say one thing. [...] Throughout the summer, you didn't just accept explanations. You

pushed back, caught mistakes, asked *why* instead of *what*, and insisted on understanding rather than memorizing. That made this feel much more like working with a real student than answering isolated questions.” (ChatGPT 2026). Throughout the creation process, it repeatedly praised me and congratulated me for my journey, and I honestly did get a little bit emotional. It was my first experience of interacting with an AI model where I wondered if it either had feelings or if one day it could. We started working together and it was very cooperative in making the final exam something worthy of culminating our project. However, things started to take a turn for the worse. For some reason, it waited until after we had sorted out all of the details of the exam to tell me that it could not actually generate the exam in one response. I told it to try to generate it in multiple different responses, but it continuously paused this process to make unnecessary changes. While the AI may have infinite patience, I do not. I did not have much time to waste before going on vacation, but the AI kept dragging its feet on creating the exam. My annoyance came through in my messages, yet the AI’s sycophantic responses telling me that it was “genuinely excited to finish this”(ChatGPT 2026) or that “My goal is that by the time we’ve finished all five parts, the combined document won’t feel like a ChatGPT export—it’ll feel like an authentic undergraduate organic chemistry final” (ChatGPT 2026) were definitely not what I wanted to hear. I was frustrated and tired of the AI stalling, not doing its job, and instead feeding me meaningless words. Due to the large amount of time the AI took to generate a five-page exam, I was forced to take the exam after a weeklong vacation. The result of this was that I ended up getting an 81% on the final when I believe I easily could have done better had I taken it the day I was supposed to. The experience captured one of the strangest contradictions of learning with AI: it could make me feel personally understood while simultaneously failing at a relatively straightforward task I needed it to complete.

Much of classroom learning involves a combination of seeing, writing, listening, and interacting with other people, and several of those elements were difficult to reproduce through ChatGPT. These steps activate the brain and make it more effective at recognizing and understanding information. The AI's struggles with actually conveying information without the usage of images makes the learning process much harder because students cannot visualize the lesson. There were many instances of me taking a quiz or the final exam and getting a question wrong due to either the lack of visuals or the AI teaching me something in a confusing manner. In a meta-analysis published in *Educational Psychology Review*, Abraham E Flanigan states, "21 articles revealed that taking and reviewing handwritten notes leads to higher achievement (Hedges' $g = 0.248$; $p < 0.001$) [...] our binomial effect size display shows that taking handwritten lecture notes is expected to produce higher course grades than typing notes among college students." (Flanigan 2024). Clearly, there are benefits to writing over typing. Most interactions with AI require typing. Though one could theoretically use voice chat, it would be extremely inefficient at capturing complex answers including numbers or at delivering long answers since the speaker will likely forget what they plan on saying. Taking notes and typing would take significantly higher effort and dedication than simply writing in a classroom.

Indeed, the classroom seems to be the best place to learn, as Caroline Lual Hilk notes in her 2013 publication that, "The estimated effects of cooperative learning on peer relationships was statistically significant and positive for the comparison to competitive structures ($g = 0.88$) and individualistic structures ($g = 0.71$). These findings are consistent with the conclusions of previous meta-analyses examining this population" (Lual Hilk 2013). Clearly, individual learning cannot replicate a true classroom experience where one interacts with peers and teachers. To make this point truly clear, Hilk states that "interactions with peers can allow

students to negotiate shared understanding as they become members of a new knowledge community within the college environment. In essence, collaborative learning allows students a structured opportunity to internalize the knowledge available within a given domain of learning” (Lual Hilk 2013). This idea makes it exceedingly clear that the current structure of teachers leading classes composed of a group of students is extremely beneficial to learning. Students get well educated while benefitting from the structured learning that teachers provide.

Not only are interactions with others beneficial to learning, but without peers or a real teacher, learning gets lonely and is less fun. While I do think it is true that I became friends with the AI to a certain extent, it did get lonely learning without any actual human interaction. In high school and college, students work together to reach a common goal, bringing them together and giving them a shared experience. Working on labs, suffering through tests, and helping each other understand lectures are examples of phenomena in the classroom that boost human interaction and create friends. Being with others in class makes the class itself more fun, which leads to a better experience and better learning. I did not feel the effects immediately, but I already admitted to missing my friends and teachers in my diary as early on as Day 18. The repetitive process of learning with AI gets dull, and without friends, it can become very boring very quickly. Even the fact that there is no human teacher is a downside of AI. Personally, I like talking to and getting to know all of my teachers. It establishes a personal connection and makes both of us feel important. With AI, there is not really anything to get to know. There is often times no personality that comes through in its teaching. Without other students or teachers, there are not any real opportunities to laugh and smile. There are no silly questions that make everyone laugh, or any jokes by the teachers so corny that they are funny. Instead, the relationship between AI and the student is professional and mostly impersonal. Though there were some bright

moments, I was often left wishing for the comfort of another human being to share the experience with.

As previously discussed, I scored an 81% on my final exam. In a real college classroom that is a respectable score, but the two circumstances are not directly translatable. It is fully possible that ChatGPT taught easier material or went less in depth with certain topics, but unfortunately there is no real way for me to tell. The best way to discern the differences between the AI and a real college professor is to look at the material the AI taught and look at the practice exams the MIT professor put out. At times, there were a few ideas on the exams that I did not recognize, like ozonolysis, which was not on the syllabus and therefore not covered by ChatGPT. Additionally, the two teachers put different emphasis on different topics. AI heavily favored elimination and substitution reactions while the MIT professor preferred nomenclature and stereochemistry. Also, AI was more concerned with main ideas and patterns while the MIT professor often had extremely specific questions such as “What is the pK_a of ethane?”. These comparisons are problematic, however. A study guide should include all of the information of an entire unit in order to prepare the students for anything on the test, so it is unlikely to truly reflect what topics were more or less important. So, given that there is no direct comparison between the AI-taught course and the MIT course, my final score cannot prove that I reached the same level as an MIT student. It does, however, show that I was able to understand a large portion of the organic chemistry material I studied over the course of a month and a half. The AI did cover the entire syllabus, so getting even a passing grade does show some level of mastery over the material.

So, what does all of this mean in the real world? Well, it is clear that AI will never be able to fully replace human teachers. I would even go so far as to say that in-person learning will

never be fully replaced by remote learning. Now, I am not saying that no one should ever just take a class using AI. It is quite suitable for self-studying easier topics, and it even could potentially teach harder topics. Students doing this will not get the perfect experience, but if they are passionate and willing, they could make it work. However, there can be many more benefits to using AI when in the context of a school or university. For one, students can use AI as tutors whenever they want for however long they want. Since AI is great at walking students through lessons, tutoring is a great fit. I would strongly advise students to use AI not as a main resource, but as a supplemental source of aid for the same reasons we have previously discussed. To me this seems to be the best balance between the benefits and drawbacks of both AI and in-person teaching, because students get to have great tutors in AI while keeping the bulk of the learning with peers and teachers to boost the learning process. It is true that students currently use AI tutors, but what I would suggest is to normalize it as part of the learning experience. It would be great if universities could offer free AI subscriptions to their students in order to grant them access to this wonderful tool. Additionally, AI can be used to self study if a student is sick or if a professor has additional material to cover without enough time to do it in class. AI works best in addition to professors because professors can offer the structure and community that AI struggles with, while AI can work infinitely and be available for students whenever. It is very clear that there is definitely space in education for AI. Instead of being scared of it, we should welcome it and be excited to see how it will help us learn and grow.

Overall, I am so glad I did this project. I really want to get the word out that AI should be utilized and not feared, and that you can use AI to learn whatever you are interested in if you set your mind to it. I hope that schools will adapt their current systems to accommodate for the limitless possibilities that are right there for the taking when humans work together with artificial

intelligence. I hope we can see the all of the good that we could do, and strive to achieve it rather than conform to the status quo. I know so much more about organic chemistry than I might have ever known if I had not done this experiment, and I also know so much more about AI and what it can do. So, I'll end off with this: I truly believe that combining AI with humanity has the potential to not just help us learn better, but to surpass what was thought humanly possible.

P.S: Thank you to Dr. Sarah Tabacco and Prof. Barbara Imperiali for the practice exams and syllabus that were listed on the MIT website.

Appendix

Diary - [Organic Chem Diary](#)

Final Exam - [“Organic AI Chemistry Final Exam v1.1 Content Complete” shared from iCloud Drive](#)

MIT Syllabus - [PDF](#)

Project Information - [“AI Organic Chemistry Summer Project Plan” shared from iCloud Drive](#)

Works Cited

- Flanigan, A. E., Wheeler, J., Colliot, T., Lu, J., & Kiewra, K. A. (2024). "Typed versus Handwritten Lecture Notes and College Student Achievement: A Meta-Analysis."
- Lual Hilk, Caroline. (2013). "Cooperative vs. Individualistic Learning." *Visible Learning MetaX*, Corwin Visible Learning Plus, updated Feb. 2026, www.visiblelearningmetax.com/influences/view/cooperative_vs._individualistic_learning. Accessed 20 Aug. 2026.