Future of Online Education

Online teaching has emerged as a promising solution to address education inequality. However, there is still room for improvement. *To establish best practices, pioneering institutes must streamline the process of proposing, implementing, evaluating, selecting, and promoting new techniques.* As an educator, I am motivated by the opportunity to contribute to this cause. I have had the privilege of teaching and mentoring in a wide variety of environments, ranging from remote villages where one class had to hold students of different grade levels, to developed regions where undergraduate students are financially sponsored to try out summer research projects. I believe that education is a crucial resource for individuals and that online education is one of the best solutions to bridge the gap of education inequality. I am determined to develop a reference asynchronous online course on data analysis with minimal active instructor intervention. This will help cultivate interest in students to become lifetime learners and teach them the skills to master materials on their own at a large scale.

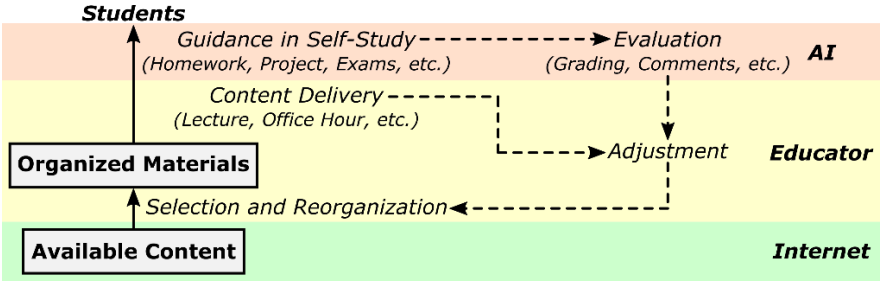
The Internet has enabled unprecedentedly convenient knowledge sharing, but online teaching is still developing. Not many educators have realized that **future online teaching has to compete with digital entertainment**: we will be competing for students' attention more and more intensely with online entertainment services, which is a new challenge since this is less of an issue in traditional classroom settings. Because of this, I know I have to go above and beyond to not only deliver the materials but consistently engage the students. In my classes, I always strive to show how interesting the topics are while emphasizing how useful the skills behind them will be to the students. I believe these two complementary and mutually reinforcing motivations are key to attracting and keeping students' attention. That being said, the quality of the online course is still the top factor affecting the learning experience. This is one of the reasons why I spend tremendous time and effort in active research projects. Mastering materials and skills myself gives me the ability to identify the most important components and reorganize them in an easy-to-absorb manner. Also, I never feel ashamed of using all the small tricks I know to engage students, such as candies in in-person classes to encourage questions. For the same reason, I am not ashamed to admit that virtual rewarding systems widely adopted in modern digital entertainment industries are extremely effective. Furthermore, I am ready to implement them in my reference online course. I would emphasize learning but take advantage of the scoring system because it serves as an effective motivation, and I will recommend the same to my colleagues.

Under this situation, the student-oriented approach in course design and teaching has become more important than ever. Online educators must care about their students and prioritize effective learning over efficient teaching. While teaching and mentoring, I frequently ask myself the rule of thumb question "Will this approach help students learn better or just make my life easier as an instructor?" For instance, I am against the linear course structure popular in current education practice, where instructors assume topics covered once would be mastered by students. On the contrary, I believe multiple exposures to the same topic are crucial for students to truly master that topic. My lectures highlight (i) high-level mental maps to help students properly set expectations and easily navigate through different topics and (ii) repetitions of important ideas in different formats, including preview, review, and example problems hitting previously introduced key concepts. And I am always ready to remind students of a covered topic as needed. As another example, I am also not a big fan of the best practice of fragmented learning widely accepted by today's online courses, featuring short video segments with simple fact-checking questions in between. Properly training students requires long, intense concentration from them. Fragmented learning, at best, is only an easy way of delivering simple knowledge. Often, it may only provide an illusion to students that they have learned something because the knowledge gained that way is hard to retain. Instead, I would try my best to increase the addictiveness of my online course based on modern game design techniques so that students are willing to spend a lot of time and effort going through the materials. With this consideration, even a teacher's charisma or teaching behavior matters. In my classes, I prefer the style of writing on the board compared with PowerPoint to limit my speed to a degree that is easy for students to follow.

In addition, this student-oriented attitude allows me to naturally adapt to students' levels and backgrounds. For example, in 2016, I delivered four talks that I designed on the introduction to electrical and computer engineering (ECE) to undergraduate students at the College of Liberal Arts. These talks selectively covered both basic ECE knowledge and advanced discussions on AI. I received an average student evaluation score of 4.7/5.0, with students praising my teaching skills in their feedback comments. They noted that I was knowledgeable about the topics,

articulate, and understandable, and that the delivery was similar to or better than that of a native English speaker. I have been using these skills as a researcher, too, and have won several technical presentation competitions.

Good online education is different from good traditional education. Good online education today is different from good online education a decade ago. The growth of online education and the rapid coverage improvement of the Internet over the past decade makes it possible for more and more people to get access to an overwhelming amount of free educational materials online. Considering this, repeating existing courses in an online format now does not add much value. Developing new courses and better versions of existing courses is a better way. At the same time, **the rise of AI brings challenges and opportunities to online education**. With the fast development of super AI chatbots represented by ChatGPT, the normal standards and best practices will change dramatically again in the coming decade.



Instead of worrying about AI taking over me as an educator, I feel excited about and am ready to explore this development in aiding me so that I can reach more students without compromising teaching quality. In the short term, I am willing to try relying on AI mainly or completely for real-time guiding and grading students in self-study activities. This way, I can focus on (i) selecting the best content to teach and (ii) developing techniques to better organize the materials and engage students. In the long term, I believe the irreplaceable value of human educators lies in encouraging students to become interested in a topic, for example, as role models. Another implication of this fast AI development is that although knowledge memorization is still required, access to knowledge, in general, will be easier and easier, and the cost of fetching the correct knowledge will be lower and lower. Along this direction, teaching the skills of self-supervised education is more important compared with teaching specific knowledge. For this reason, I would also teach students the skills I use as an educator, including AI, so that they can preserve the attitude of active exploration and keep developing valid methodologies for solving problems outside of my class.

At last, I would like to conclude my statement with a list of selected techniques for the reference online course I would like to develop myself. These techniques may appear aggressive with today's standards, but they can be easily tailored as needed. And I am always open to collaboratively investigating their effects with other colleagues who are interested in trying them out.

- Modern Magic: Digital Signal Processing and Analysis
- 2D-matrix style structure: each element is a required or an optional module for a skill & topic combination.
    - Columns: skills to cover in increasing difficulty, for example, signal generation (digital sensors), time domain representation, time domain techniques, frequency domain representation, frequency domain techniques, and big data analysis (parallel computing; machine learning)
    - Rows: example topics (materials) to repeatedly and incrementally teach the desired skills, for example, 1D signal (audio; temperature; soil moisture), 2D signal (image), 3D signal (geographic data), and large-volume datasets (statewide LiDAR).
- Game design techniques applied to online teaching to boost motivation
    - Points for each completed required module and extra points for each completed optional module
    - Unlocking new modules and project-based challenges by earning points
    - An interactive skill tree to highlight study progress and provide extra materials
    - Anonymous leaderboard with real-life rewards/prizes for top winners
- Community for peer mentoring: online study rooms and study groups organized by topics
- Extra course evaluation: the trend of students' grades in other courses before vs. after they take this course