

AI & EDUCATION SUMMIT

Enhancing Teaching with the Implementation of AI Technology

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Abstract

In this presentation, we will discuss recent initiatives by the International School of Boston to implement AI technology in STEM education and explore ways to enhance STEM learning using these technologies. We will begin by introducing the activities we use with our students to teach Python in math class using Generative AI tools, and then we will discuss the pros and cons of our method. We will then describe follow-up projects that use Generative AI in the classroom to improve students' math and science writing, enhance problem-solving skills, and increase students' autonomy in test preparation. Additionally, we will present various pilot programs at the International School of Boston, and a planned computer science course featuring AI technology for the 2024-2025 academic year. We hope this presentation provides an opportunity for discussions with anyone interested in implementing new ideas in education and developing partnerships with our school.

Introduction

Since the emergence of Generative AI last year, there has been a proliferation of educational apps, including ChatGPT, Perplexity, Gemini, Grammarly, Midjourney, etc. This paradigm shift is impacting all aspects of society, particularly modern education. According to a recent survey (Schiel, 2023), 54% of students do not use AI, primarily because they are either not interested in it or do not know how to use it. Among the 46% of students using generative AI in their studies, only 30% use it in mathematics and 37% in science, while a majority (66%) use it for writing and language courses. Surprisingly, only 17% of the students who use AI apply it in computer science, and just 15% use it to get help with coding (outside of school assignments). Therefore, it is clear that schools need to integrate AI, specifically generative AI, into their curricula to support students in their AI usage and prepare them for the job market of tomorrow. Indeed, jobs in STEM require more AI skills, making it urgent to teach our students generative AI and provide them with a solid AI background.

In the past three years, the International School of Boston (ISB) has developed initiatives to implement AI technologies within its curriculum, extra-curricular activities, and pilot programs. The goal of this presentation is to explain ISB's strategies to improve our students' literacy in AI and to describe how we envision enhancing their learning experience using AI.

Implementing AI in our STEM classroom

Generative AI in math. ISB has been engaged in developing teaching materials and strategies to integrate generative AI within the STEM disciplines. For example, in the math class, we developed activities that utilize generative AI to improve the Python coding skills of students. The goal of these activities is to use generative AI for completing and generating new code segments. We observed that students are becoming more efficient

in coding using AI tools and can work independently. However, we noticed that students can rely too much on these tools and the danger of using them too systematically is that they don't learn the programming skills enough to be able to work independently. Therefore, it is important to organize the lesson to train students to use AI tools first and then to remove the tool to make sure they have learned the programming language. One of the future goals of this research is to separate a group of students into two subgroups with heterogeneous levels in Python programming (determined using placement tests): one using the generative AI assistive method, and the other without using it. After giving them two different but similar activities aiming to learn Python coding, we could compare the results of the two subgroups and see whether the use of Generative AI effectively enhances the learning.

As a follow-up project, we would like to use a similar method to see whether the use of Generative AI can improve math writing, especially for students with special accommodations. In particular, students facing language challenges, often experience difficulties with math writing. The integration of math and language can sometimes be a difficult task. The objective of the proposed activity is to enable students to use generative AI apps to refine the phrasing of their solutions to problems. We could also study the potential improvement of problem-solving skills for some students who experience difficulties in translating word problems into mathematical equations. These students could benefit from using generative AI to analyze and understand the language of the problem better. This tool could help them grasp the underlying concepts more clearly, enabling them to abstract the problem and identify the appropriate mathematical concepts to solve it. Finally, we are developing new strategies to increase the autonomy of students to review for their tests using the Magic School application. This strategy involves using generative AI to create personalized review questions, which would help students practice and strengthen their understanding in areas of math where they are struggling. Tools such as Magic School will be employed to facilitate this process. In the presentation, I will show a couple of examples of activities planned for our math classes next year.

Pilot programs and tech culture at ISB

Developing research skills using Generative AI. Last year, we created a STEM Research Seminar course at ISB for junior students. This one-semester one-hour/week course is open to students interested in doing a summer internship (see next paragraph). This course is designed to introduce students to academic research standards. Students study techniques to conduct research on a topic in the STEM fields, learn how to communicate efficiently with their peers about their research work and develop networking skills with the scientific community. In the curriculum, we included technology training, such as latex typesetting, spreadsheets, and Python coding. This year, we trained students to use Generative AI tools for different tasks. First, Generative AI is a great tool to develop students' latex typesetting skills, e.g., Chat GPT can give latex template code that can be inserted in a latex document or can complete/correct lines of codes. Second, Perplexity can be used to search for documentation (articles, lecture notes, etc...) on a specific topic and to provide online access to the sources. It can also be used to summarize PDF files, which helps students grasp the core material of a research paper. It is nevertheless important to show our students the limitations of using Generative AI tools, particularly for citing papers. This task is not properly performed by these AI tools and students should use standard research methods to find the correct citation of a reference. Examples were shown to our students in this class to warn them of the potential improper use of AI tools.

MIT internship and machine learning. For the past three years, ISB has developed a partnership with MIT, specifically with Prof. Muriel Médard's research team (Network Coding and Reliable Communications Group) at the Research Laboratory of Electronics (RLE). The partnership involves four to six ISB students participating in a summer internship. During these internships, they collaborate with post-doctoral researchers

and Prof. Médard on advanced research projects that involve machine learning applied to communication. Last year, with the guidance of their mentors, five of our students successfully adapted a neural network code written in Python to calculate the mutual information between images. They produced a five- to ten-page report using LaTeX typesetting and delivered an oral presentation at the lab at the end of their six-week program. As a visiting researcher in the lab, I had the opportunity to mentor and observe the students during their internship. This experience demonstrated that the concepts of machine learning can be made accessible to high school students through a project-based learning approach with appropriate guidance and background instruction.

New Pilot program: Future Tech. Next year, ISB will start a new 9th-grade course entitled “Future Technology” in which AI will be implemented in the curriculum. Our goal is to introduce AI technologies (basic machine learning concepts, generative AI) and to equip students with critical thinking and fluency in AI. We hope this pilot program will lead to the design of a more extensive AI-based curriculum for 9th- and 10th-grade students and will inspire students to be engaged in AI-related activities, such as implementing AI in STEM clubs.

Café STEAM and Artificial Intelligence. On January 24, 2024, we organized Café STEAM at ISB: “From Artificial Intelligence to New Frontiers in Math and Physics” in partnership with the Institute for Artificial Intelligence and Fundamental Interaction (IAIFI) with two guest speakers: Prof. Nina Necib (MIT Kavli Institute for Astrophysics and Space Research and IAIFI) and Prof. Fabian Ruehle (Northeastern University and IAIFI). Our goal is to repeat this event every year and eventually organize an AI fair at ISB where students will showcase their work on AI and guest speakers will present their research.

Conclusion

In the past three years, ISB has undertaken several initiatives to implement AI within and outside the curriculum. We have utilized generative AI to enhance the Python programming skills of our students and plan to engage in further quantitative research to study the impact of the implementation of AI in our STEM classes, in particular, to determine whether AI could enhance the learning progress for math/science writing, problem-solving, and independent review of students before tests. Additionally, we have also experimented with the integration of Generative AI to develop research skills in the STEM Research Seminar class. Other projects have been developed, such as an internship program at MIT where students learn deep machine learning and the creation of a Seminar (café STEAM) where guest speakers came to talk about recent progress in the AI field. Recognizing AI as a paradigmatic shift in education, ISB is committed to offering pilot programs to explore new avenues in this emerging field. We welcome opportunities to develop new partnerships with educational institutions and/or stakeholders in AI to further our investigations in this direction.

References

Schiel, J., Bobek, B. L., Schneider, J. Z. (December 2023). High School Students’ Use and Impressions of AI Tools. ACT Research, December 2023.