Engaging Students through Creativity: The Impact of Arts-Based AI Education Programs on Middle and High School Student Conceptual Understanding and Interest

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Over the past 5 years, our research consortium has developed a series of visual arts and narrative based AI education interventions, which have been deployed and tested in Asian (Beijing and Shanghai) cities as well as current/ongoing testing in multiple US cities (Chicago, Boston/Brockton, MA regions), with approximately 50 youth have undergone the program and associated research, the majority of which have been in middle school students.

This arts and narrative-based approach was developed as a response to prior work indicating that youth were interested in a self-guided program, that allowed for maximum creativity. Students were encourage to develop their own AI-assisted artistic works, ranging from short form videos / music videos, to poetry books, to children's picture books and other forms of narrative expression. Students were exposed to both programming-based AI activities as well as less academically intensive application-based AI activities as well, which were fun/engaging but also addressed and exposed youth to key AI concepts.

Research has show that the combination of arts into other disciplines (aka STEAM) has been effective in terms of maximizing student creativity and sense of personal ownership of their work.

An arts-based AI program is -engaging for middle and high school students for several reasons:

1. **Creativity and Expression**: Art allows students to express themselves creatively, making learning more enjoyable and personal. Engaging with AI through art can spark their imagination and foster a deeper connection to the material.
2. **Interdisciplinary Learning**: Combining arts with AI introduces students to interdisciplinary learning, merging technology with creativity. This approach can appeal to a broader range of interests and talents, making STEM subjects more accessible and less intimidating.
3. **Hands-On Learning**: Art projects often involve hands-on activities, which can be more engaging and memorable than traditional lecture-based instruction. These activities can help students better understand complex AI concepts by applying them in a tangible way.
4. **Real-World Applications**: Arts-based AI programs can demonstrate real-world applications of AI in creative fields such as music, visual arts, and media. This relevance to everyday life can increase student interest and motivation.
5. **Collaborative Opportunities**: Art projects often encourage collaboration and teamwork. Working together on creative AI projects can build communication and social skills, making the learning experience more enjoyable and supportive.
6. **Personal Identity and Inclusion**: Artistic projects can be tailored to reflect students' personal identities and cultural backgrounds, promoting inclusivity and a sense of belonging. When students see themselves represented in their work, they are more likely to be engaged.
7. **Critical Thinking and Problem-Solving**: Creating art with AI tools requires critical thinking and problem-solving skills. These skills are essential for success in both academic and real-world contexts, making the learning process more meaningful and applicable.

Overall, an arts-based AI program leverages the natural appeal of creativity and personal expression to make learning more engaging and effective.

The majority of students in the interventions had at least some exposure to computer science, mainly in the form of block languages or limited introduction to Python. In addition students were familiar with algebra and related math. While some students were familiar with AI applications and video games, nearly all students had no direct exposure to AI concepts or programming.

Youth were treated with up to 20 hours of AI educational content in school-affiliated and OST programs, focusing on middle and high school students. Classes have been taught predominantly virtually (in a synchronous manner, with all students attending via webconference) as well as in some cases with in-person support in addition to language translation and class management assistance.

Students were largely exposed to virtual / application based arts activities, although when possible, some students were provided with hands-on artistic experiences as well, involving the creation of "artistic robots" as well as 2D hybrid art involving the transfer of AI-generated art to canvas, and then accenting the art with acrylic paints and other physical drawing/painting media. Students were also asked to generate their own physical art for use in the development of Teachable Machine models, and in other web-based AI education platforms.

In addition, students engaged in the following AI CV concepts: neural art style transfer, generating original art using stable diffusion, Google DeepDream, creating brush-stroke like textures utilizing python utilities developed at CMU, publicly available on GitHub. While some applications used were entirely web-based and did not involve programming such as Teachable Machine, the majority of student programming work involved modifying existing templates in a directed manner, and this work was conducted either on Jupyter Notebook, or using Anaconda local installations. Students engaged with cutting edge models such as SDXL as well as a number of newer LLM's, in order to conduct their creative work, and to explore qualitative differences between models.

Clinical interviews were conducted after the studies in China. In addition, an instrument was developed to evaluate interest/engagement in AI and related subjects as retrospective pre-post questions, as well as general STEM identity measures. The results of the interventions thus far are positive, indicating that students enjoy the ability to demonstrate their understanding of AI concepts through artistic expressions, with minimal restrictions on the mode of their work / final project.

For the last class, students were asked to present a final, culimating project to the rest of the class. Student were permitted to create a narrative and/or visual media presentation of their own choosing, as long as they could incorporate and explain key AI concepts, in particular if those concepts could align with the AI4K12 Big Ideas in some explainable way.

Highlights from the research outcomes of one key cohort indicated that: ~Ninety-five percent (95%) of respondents said that they conceptually "understand AI much better now"; ~75 % said they'd like to enter an AI-related career in the future; and 85% reported that they are likely to do a science project (or another form of independent research) using AI.