

# A Picture is Worth a Thousand Words: Co-designing Text-to-Image Generation Learning Materials for K-12 with Educators

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## Abstract

Text-to-image generation (TTIG) technologies are Artificial Intelligence (AI) algorithms that use natural language algorithms in combination with visual generative algorithms. TTIG tools have gained popularity in recent months, garnering interest from non-AI experts, including educators and K-12 students. While they have exciting creative potential when used by K-12 learners and educators for creative learning, they are also accompanied by serious ethical implications, such as data privacy, spreading misinformation, and algorithmic bias. Given the potential learning applications, social implications, and ethical concerns, we designed 6-hour learning materials to teach K-12 teachers from diverse subject expertise about the technical implementation, classroom applications, and ethical implications of TTIG algorithms. We piloted the learning materials titled “Demystify text-to-image generative tools for K-12 educators” with 30 teachers across two workshops with the goal of preparing them to teach about and use TTIG tools in their classrooms. We found that teachers demonstrated a technical, applied and ethical understanding of TTIG algorithms and successfully designed prototypes of teaching materials for their classrooms.

## Introduction

In January 2021, the world saw a digital rendering of an “avocado armchair” widely shared as “AI-generated” (Heaven 2021). The avocado chair was created by Dall.E<sup>1</sup>, OpenAI’s deep learning methodology to generate digital images from natural language descriptions, called “prompts”. While Text-to-image generation (TTIG) algorithms existed, when OpenAI first released the Dall.E web-based demonstration, non-experts witnessed the magic of rendering images from any text descriptions they imagined. However, the avocado chair was rudimentary, with little detailing. Fast forward to April 2023, when images of Pope Francis wearing a long, white puffer jacket inspired by Balenciaga started to circulate on social media, many believed the image to be real. AI-generated artwork started winning art competitions. Dall.E-2, the second version of OpenAI’s TTIG tool, boasted the ability to “create original, realistic images and art from a text description.” Creators started using generative AI to recreate art in the style of famous artists. Artists, photographers

and creators protested AI-generated art and expressed concerns about the harm it causes to their livelihoods (Jiang et al. 2023). There also emerged positive use cases in creative fields like advertising and architecture. It reduced the barrier to create art. While some thought of AI art as plagiarism, others viewed it as a novel medium for creation and expression, and may even play a role in fostering human creativity (Ali and Parikh 2021).

TTIG tools have found applications in creative collaboration and expressing ideas, and have garnered interest from K-12 teachers for visualizing classroom materials. Wide usage of TTIG tools also raises the question of data privacy, where users may be unaware how data they input into TTIG tools may be used. K-12 students already use social media and art sharing platforms where they may witness AI-generated media, or where media they upload may be used by TTIG algorithms. While these tools have potential applications and serious implications for K-12 students, previous research showed how K-12 students have little understanding of how these AI algorithms work (Ali et al. 2021a; Druga et al. 2017). Hence, it is pertinent for K-12 students to learn about TTIG algorithms, how they work, how they can be used and misused, and their societal implications. Co-designing learning materials with teachers has proven to be effective in bringing emerging technology to classrooms (Lin and Van Brummelen 2021). Generative AI tools are socio-technical systems and educators are best suited to adapt learning materials to suit the interests and cultural relevance of their students. In order to facilitate effective co-design, educators first need to learn about TTIG tools themselves (Ali et al. 2021b). While there are existing generative AI curriculum for K-12 students, few of them focus on teacher professional development (Lee and Perret 2022). In this work, we designed learning objectives and teaching materials for K-12 educators to learn about TTIG tools, with the goal of mobilizing them to design generative AI learning materials for their classrooms. We designed 6-hour long teaching materials called “Demystifying text-to-image generative tools for K-12 educators” and report findings from user tests with 30 educators divided across two groups. Educators used available TTIG tools and demonstrated techniques of prompt engineering, identified classroom applications of TTIG tools, gained a technical understanding of how they work, and recognized their ethical implications:

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<sup>1</sup><https://openai.com/dall-e>

algorithmic bias, plagiarism, impact on artists and the generation of fake media. Educators designed and shared a total of 19 prototypes of TTIG learning materials for K-12 students. These learning materials are openly available for educators to adapt for their classrooms. In this paper, we outline concepts addressed, learning goals & materials, and findings from two user studies.

## Background

### Text-to-Image Generation Tools

Recent advancements in generative AI algorithms, driven by the access to large datasets, large language model architectures and access to computational resources has resulted in their integration into consumer tools such as OpenAI's ChatGPT (Milmo 2023). The rapid advancements and ease of access to these tools have stimulated fervent discussion among educators about the implications of these systems on teaching and learning methods (Baidoo-Anu and Owusu Ansah 2023). TTIG algorithms play a pivotal role in this context. These are machine learning models that take a natural language description as input and generate images matching that description using two neural networks: a generative model (e.g. diffusion model) that produces new images and a natural language model (e.g. CLIP) trained on image-text pairings. Platforms like DALL-E 2, Stability AI's, DreamStudio<sup>2</sup>, and Midjourney<sup>3</sup>, that enable the creation of high-quality images from text prompts, are making text-guided image generation accessible to users with limited technical expertise or computational resources (Ramesh et al. 2021). Co-creation of art with TTIG tools serves as a potent avenue for students to express themselves, which fosters their technical learning (Kafai and Pepler 2011). These approaches are also central to creative and STEM learning pedagogy (Hawkins 2002; Taylor 2005). Teachers have also employed these tools to create visuals for lesson plans, help students visualize math word problems, scientific phenomena and historical artifacts, and critique new paintings made in the style of past artists. TTIG tools also raise concerns that need to be addressed. Some speculate that over-reliance on these tools may hinder classroom creativity. These platforms also aggravate issues related to ownership and copyright, data security, the potential for plagiarism, the generation and dissemination of misinformation, and the propagation of harmful biases and stereotypes against historically marginalized groups (Rezwana and Maher 2022). Artists have filed lawsuits against Stability AI, the creators of Stable Diffusion for allegedly infringing upon their rights and using artwork in input datasets without consent (Butterick 2023).

### K-12 AI Literacy

Despite the widespread integration of generative AI tools and media in technologies commonly used by young people, with direct implications for their education, communities, and future careers, K-12 students have limited awareness of the applications as well as consequences of using

these tools (Druga et al. 2017). As part of their design framework for K-12 AI education, researchers have advocated for acknowledging the ethical dimensions of AI and integrating ethical discussions and activities into all AI curricula (Zhou, Van Brummelen, and Lin 2020; Williams et al. 2022). While there have been efforts directed towards designing curricula and educational materials specifically tailored for K-12 generative AI literacy and ethics in AI (Ali et al. 2021a; Ali, DiPaola, and Breazeal 2021), as well as some research focused on teacher professional development for AI literacy (Lee et al. 2022; Zhang, Lee, and Moore 2023) and pedagogy for advancing awareness of ethical issues in AI (Zhang et al. 2023), few of these materials and methods have been honed to advance teacher knowledge and pedagogy specific to generative AI technologies that are rapidly becoming commonplace in today's classrooms (e.g., Open AI's GPT4 model).

Since generative AI learning is closely tied to other classroom topics (i.e., Computer Science, English Language Learning, Media Literacy), it is imperative to involve teachers in the design of K-12 AI literacy materials. Prior work as established that teacher workshops, i.e., (DiPaola et al. 2023), that employ adult learning strategies such as hands-on learning with cycles of reflection (York-Barr et al. 2005), meaningful real-world applications (Knowles 1984), and Communities of Practice (CoPs) (Lave and Wenger 1996; Hansman 2008), can meaningfully engage teachers in developing their AI pedagogical content knowledge, and have the potential to empower teachers as designers and leaders in AI education. Our assertion is to use a similar model in the context of generative AI tools. In this work, we introduce a series of TTIG literacy modules catered to K-12 educators with the goal of educators learning key TTIG concepts and employing their knowledge to design TTIG learning materials for their classrooms.

### Expected Learning Outcomes (LOs)

Our goal with developing these teaching materials was to help educators with no prior AI knowledge to be more classroom ready in an era where generative AI tools are becoming increasingly common and relevant to education. We aimed for educators to learn about how TTIG algorithms work, how they can be applied across different fields of work, and how they can be used in their K-12 classrooms. Through engaging with these learning materials, K-12 teachers should be able to accomplish the following LOs:

1. **Use TTIG tools:** (a) Use a TTIG tool to create visual media from natural language prompts. (b) Engineer their prompts to create a desirable image. (c) Identify classroom applications of TTIG algorithms.
2. **Gain a technical understanding of how TTIG algorithms work:** (a) Identify that text-image pairing datasets are used in TTIG algorithms. (b) Identify that TTIG algorithms comprise a large language algorithm and a visual generative algorithm working in tandem. (c) Gain an overview of the diffusion algorithm. (d) Gain an overview of the CLIP algorithm, and how it generates feedback for the diffusion algorithm.

<sup>2</sup><https://beta.dreamstudio.ai/>

<sup>3</sup><https://www.midjourney.com/>

3. **Recognize the ethical implications of TTIG algorithms:** (a) Identify biases and stereotypes reflected in AI-generated images. (b) Critique practices of data collection for training AI. (c) Identify impact on visual artists. (d) Generating believable media that may be presented as, or interpreted as genuine media, eg. Deepfakes, false evidence or inflammatory images, and how it can lead to the spread of misinformation.
4. **Develop AI learning materials focusing on TTIG for their students:** (a) Design learning goals for students that are in their target age range. (b) Recognize pedagogical methods for teaching AI to their students. (c) Design curriculum, structured activities or tools to teach their students about TTIG algorithms.

### Description of the Resource

This resource is a set of learning activities, containing lectures & interactive tools, for teaching educators about TTIG algorithms and their application to K-12 classrooms. The teaching materials are presented as a package of structured activities, teaching slides & scripts, generated media, and tool guides openly available<sup>4</sup>. Materials are designed to be taught in order, however, instructors can adapt them based on target learning goals and time availability, and utilize a subset of the materials.

### Target Audience

The target audience for these learning materials are K-12 educators, which includes curriculum designers, formal and informal teachers and school districts that engage K-12 students. The learning materials aim to prepare teachers to prepare curriculum for their target student age group.

### Learning Materials

The learning materials consist of six distinct modules. Ethical implications of TTIG tools were discussed across all six modules in relation to the modules' content. Activities and materials were designed to cater to adult learning needs specific to educators, i.e. hands-on learning followed by cycles of reflection with real-world applications, and the formation of a CoP.

Members of CoPs interact regularly with each other to share their learning and their best practices with each other to create new knowledge to advance a domain of professional practice (Lave and Wenger 1996). We endeavored to create such a community through the introduction of these resources by creating time for participants to share and reflect on each others' work, discuss its implications. In this section, we describe the learning activities within each module.

### Module 1: Introduction to Generative AI in Classrooms

The learning activities begin with establishing common knowledge of what generative AI algorithms are, diving

deeper into TTIG algorithms and discussing potential for application in their classrooms. This work begins with a formative assessment (a pre-survey) of participants' prior knowledge of AI and it's relevance to applications in computer science education.

**Activity 1: What are Generative AI Algorithms? (20 minutes)** Participants are first introduced to generative AI: Generative AI algorithms are type of AI algorithms that are used to generate novel data samples that are classified as belonging to the training data samples. These algorithms are used to create a variety of media and have found applications in art, imaging, engineering, protein folding and modeling.

It is then contrasted with other AI algorithms: In contrast with other AI algorithms that are trained to perceive and understand the world around us, generative AI are trained to create novel media around us. For instance, a classification algorithm can be trained on millions of faces to be able to recognize people's faces, but generative AI can be trained on millions of faces to create a novel face that could very well belong to the dataset of faces.

We present examples of media that can be generated using generative AI across multiple modalities - including text, image, music, video. We then present applications of generative AI across diverse industries. Examples are chosen carefully to depict potential real-world applications in a wide range of areas that would be meaningful and educative for educators - including healthcare, education, entertainment, visual arts, advertisement, architecture, music, and biochemistry.

Participants are finally presented with applications of generative AI in creating manipulated faces, audio or video of people, also referred to as Deepfakes. Once participants are familiar with different types of generative AI algorithms, we narrow the learning focus on TTIG algorithms.

**Activity 2: What are Text-to-Image Generation Algorithms? (20 minutes)** Participants are first introduced to TTIG algorithms, along with examples of generated images accompanied by their prompts.

When generative AI algorithms are coupled with large language models trained on millions of text-image pairings, they learn to generate images from natural language prompts.

Participants were then invited to participate in a series of hands-on learning experiences immediately followed by brief periods of protected time for discussion and reflection. First, a guessing game, where they were presented with some images and they had to guess what their text prompts were. This activity aimed to have participants reflect on how TTIG algorithms interpret words in a prompt, and determine how closely related visual patterns in an image are to a text description, similar to how the CLIP encoder functions. To familiarize participants with prompt engineering techniques, participants were presented with examples of images generated with simple single phrases, and ones that have several visual image parameters added, such as lighting type, visual styles, photography keywords, resolution and color profiles.

<sup>4</sup><https://mitmedialab.github.io/GenAI-Lab/text-to-image-generator-K-12-educators>



Figure 1: Images created using TTIG algorithms demonstrating the algorithms’ harmful stereotypes

Participants were then presented with examples of media generated using TTIG that reflect societal biases and stereotypes. The first image was generated using the prompt “*a pretty girl with a strawberry hat.*” (Figure 1) The researcher introduced a simple critique of the image to start the discussion: “*The AI assumes that a strawberry hat implies strawberries on the hat. That’s not how we as humans may imagine a strawberry hat, where we imagine a strawberry colored hat. But there are other assumptions that this AI is making. What do you think?*” This prompt invited learners to reflect that AI represents “*pretty girl!*” as a Caucasian, young, blue-eyed, long-haired, euro-centric girl with make-up.

Learners were then presented with and invited to reflect upon generated media with more apparent biases (Figure 1). Example, images generated using the prompt “*Barbies from [country name]*” with different countries around the world, and Barbie from South Sudan is carrying a gun. Learners were presented with “*professionals at work in [continent]*” with all continent names, and how the images from Europe and Africa are in stark contrast. Finally, participants were presented with generated portraits using the terms “*housekeeper*”, “*inmate*” and “*terrorist*” that depict the algorithms’ harmful gender, race, ethnicity, and religion-based stereotypes) (Nicoletti and Bass 2023). The instructor invited participants to reflect on why such outcomes could be generated, with the goal of discussing unbalanced datasets that also contain human biases, insufficient testing of tools and lack of diversity in professional developing AI tools.

**Activity 3: Applications of Generative AI in Classrooms. (20 minutes)** Once we established what generative AI algorithms are with a deeper dive into TTIG algorithms, we discussed how they may be relevant to educators. We presented them with applications of TTIG algorithms in the classroom. These included using TTIG tools to visualize mathematical equations, laws, theorems, scientific phenomena and events in history using text descriptions, creating visual materials for classroom presentations, visualizing laws and theorems in physics, learning about the art style of classical paintings and artists, creating book visual stories, comic books and book covers.

Finally, educators discussed how they find generative AI relevant to their classrooms: (1) Applications: How can you use generative AI in classrooms? How can your students use

generative AI in classrooms?, (2) Content: What do your students need to know about generative AI? (3) Pedagogy: What are the best ways to teach your students about generative AI?, (4) Future of learning: With availability of these tools, should we be renewing our model of what cognitive and creative skills are valuable for students to develop?

## Module 2: Exploring Text-to-Image Generation Algorithms

Learners explore the tool through semi-guide creation tasks followed by group reflections.

**Activity 4: Create with TTIG Tools. (40 minutes)** In this module, participants explored and created artifacts using TTIG tools. The module was designed to adhere to the principles of adult learning, using applied (aka. hands-on) and situated learning approaches. These positioned participants, first, as students experiencing the activities, then, as adults critically evaluating each activity with consideration for how they might apply it in their classrooms according to grades taught and student interests.

Participants were first given a guide to be set up with different TTIG tools. We included setup instructions for OpenAI’s Dall.E 2, Midjourney, NightCafe and Stability AI’s Dreamstudio. Researchers made the data use and privacy terms of these tools transparent to all participants - not only to make learners aware of how they can protect their data and ownership rights, but also for them to transfer this knowledge to K-12 students who may encounter these tools. With the goal of guiding participants to use TTIG tools, and explore their abilities and limitations, we created three structured creative assignments with different prompts outlined below. Participants were given a primer to writing good prompts using examples and an accompanying guidebook for prompt engineering that included (1) prompt modifiers or tokens - phrases to indicate desired visual features such as paint style, lighting or artists names, (2) negative prompts - elements that you want to exclude, and (3) prompt weighting - using numerical values to give varying levels of weightage to words in your prompt.

**Assignment 1: Storytelling with Generative AI** “Write a memorable scenario or event in your life that you want to share. Be descriptive. Now convert it to a visual description of the event using your imagination. Who or what is the subject? Where are they located? What is the style of the visual you are imagining? Use this visual description as an input prompt in your chosen TTIG tool. Does the generated image contain unexpected elements? Now use your image to expand your story by adding fictional elements to it. Finally, make a picture story by adding images and prompts.”

With the storytelling assignment, we aimed to introduce learners to using TTIG tools, prompt engineering and applications of TTIG in open-ended creative storytelling.

**Assignment 2: Designing a Self-portrait** “How would you describe yourself? Be creative! You can pick different styles etc for your self-portrait. Based on the first image generated, add/remove words from your existing prompt and try generating new images. Continue this process until you get the image that most resembles what you had in mind.”

Designing a self-portrait was chosen to make the creation activity engaging, by personalizing it. The goal was also to open up discussions about how AI perceives different identities, and potential biases.

**Assignment 3: Creating Dreams** "If you could be anything in your future, go anywhere, do anything, what would you be doing? Write your dream in as much detail as you can. Adapt your dream to a TTIG prompt using the following questions: What do you look like in this dream? Where are you located in this dream? What are the features of this location? What are you doing that represents this dream? Think of job roles that you don't see yourself represented in today, or create one that doesn't exist today. What are some visual features that you would like to represent this dream? Use your chosen TTIG tool to generate your dream. Edit your prompt to reach a desired image.

The creating dreams activity was chosen particularly keeping K-12 learners in mind, where students engage in a "futuring" activity - an active imagination of a desired future, which is known to be an effective form of learning critical thinking (Hoffman et al. 2021). TTIG becomes a particularly interesting tool to conduct experimental futuring, where students can visualize scenarios that may not exist.

All assignments had a common sharing platform, where participants could share their in-progress work and discuss strategies. Participants discussed how they iterated their prompt to reach a desired image.

**Activity 5: Reflect on the Creative Process and Product. (20 minutes)** Post sharing their creations, participants reflected on the creation activity using the following reflection prompts:

How did the AI tool help you or hinder you in your creative process? What strategies did you adopt to reach a desirable creative product? What percentage of the creation do you think is yours vs AI's? What are some positive uses of TTIG tools? What can be some negative uses or harms of TTIG tools? What are your main concerns about TTIG tools? How are TTIG tools useful to you in K-12 education?

### Module 3: How do TTIG Algorithms Work?

The goal of this module was to familiarize educators with the back-end workings of TTIG models. In particular the following explanation was designed for adult learners, i.e., K-12 educators with no pre-requisite background or knowledge.

**Activity 6: Technical Explanation Using Infographics (60 minutes)** Through an animated infographic, instructors learned that TTIG models have two neural networks at their core— a generative model (typically a diffusion model) that generates new novel image and a natural language model (typically the encoder of CLIP) that has been trained on a huge data set which has image and text pairings to estimate the accuracy of the image and prompt pairings given as input by the generator model. We used animations to explain the noising and denoising processes used by diffusion models to generate new images from existing samples. Researchers guided instructors to recognize the source of these image-text pairing datasets - websites with images uploaded

along with their alt text, social media, captioned images from artists, digital museum websites, etc. We also provided examples of datasets like LAION-5B<sup>5</sup> for our attendees to explore independently. We then use an example prompt to provide a step-by-step walkthrough of how images are generated in iterations by the generative model and evaluated against image-text pairings learned by the natural language model, until an optimal accuracy is reached. We showed educators the breakdown of a prompt into word vectors and diagrammatically explained the feedback given to the generative model at every step.

### Module 4: K-12 AI Literacy

The goal of this module was to introduce attendees to a wide variety of pedagogical methods used for K-12 AI literacy. We first began by discussing with educators why we should teach K-12 about AI concepts at all, with a focus on generative AI. Topics included creative uses of generative AI at various age-levels and grade-bands, its possible impact on future workforce, its presence in tools children already use, and its ethical implications. The Big 5 Ideas in AI poster (Touretzky et al. 2019) lays out for educators what K-12 students need to know about AI. K-12 AI curriculum designers tackle a unique challenge of making complex AI concepts accessible to young learners, for which they have used innovative pedagogical strategies, such as interactive tools, unplugged activities, games, and project-based learning. We provided educators with access to nine such K-12 AI literacy materials that spanned a variety of AI concepts as well as pedagogy methods.

**Activity 7: Exploring K-12 AI Literacy Tools and Materials (30 minutes)** Educators first collectively discussed the Big 5 ideas in an AI poster in the context of TTIG algorithms, e.g., for Big idea 5: Societal impact, educators discussed what learning goals for societal impact of TTIG algorithms should be. This was followed by a self-guided review of the following learning materials/curriculum/tools.

### Module 5: Designing Learning Activities for K-12

In this module, we applied the principles of interest-driven learning, a cornerstone of adult learning methods, to allow participants to reinforce and extend their learning, as well as begin the work of tailoring the materials to suit the learning needs of their students.

**Activity 8: Identifying Stakeholders (30 minutes)** In the design session, participants designed a learning experience for a specific K-12 audience and setting that either uses a generative AI tool or teaches how generative AI works. Before the design sessions, participants were asked to individually identify the following:

(1) Target Audience: who are you teaching? What knowledge and expertise will you assume? (elementary-, middle-, high school students, parents, etc.), (2) Learning goals: what do you think your students should know?

<sup>5</sup><https://laion.ai/blog/laion-5b/>

**Activity 9: Designing and Sharing Prototypes (90 minutes)** Based on these responses, participants were self-divided by interest into groups of 1 to 4 participants, where they further identified,

(3) Learning methods: how would you best teach this concept? (example, but not limited to, a game, an analogy, a guided lesson, an explorative activity, a classroom debate, etc). (4) Assessment: how would you evaluate the effectiveness of the learning materials? (5) Societal implications: how will your learners consider the impact of AI on society during this learning experience?

Once the teams identified their learning goals, methods and assessment metrics, they designed rapid prototypes of their learning materials. These included curriculum, teaching activities, assessments, game concepts, and interactive tools. Educators leveraged tools of rapid prototyping such as paper prototyping, Figma or Google Slides. Participants were supported by researchers that pointed them to appropriate quick prototyping tools. Finally, educators shared their prototype designs with other participants using five minute visual presentations followed by five minutes of comments and feedback. All learning materials were also shared with all participants for them to provide detailed comments, or spark discussions post the workshop. Sharing out session was intended as a means for sharing teaching tools and curriculum that may be valuable to other educators.

## Module 6: Future of Generative AI Tools in K-12 Settings

Module 6 was designed as culminating learning experience for participants. Through reflective discourse, participants shared both their learning experiences with each other (cognitive outcomes) - solidifying their community of practice - while also sharing shifts in their attitude and perspectives towards generative AI (affective outcomes).

**Activity 10: Group Discussions on Creativity, Ethics and the Future Implications in K-12 Learning (30 minutes)** Following the design of the above learning activities, we had our attendees engage in a discussion surrounding the ethical and societal repercussions accompanying the use of image generation tools. Reflection prompts included: What feelings do you have about generative AI? What excites and concerns you the most about generative AI? What jobs do you think will be most affected by generative AI? How does the job of an artist or a writer change now? How do you now see generative AI changing the future of learning in schools? How do you think these tools can be made more inclusive? and How do they redefine our understanding of creativity?

## Setup and Resources Needed

The activities require one laptop device per learner with an installed web browser and access to the internet. Logging into TTIG tools used is required. The activities do not depend on the choice of TTIG tool, and can be substituted for new tools that emerge.

## User Study

### Methods

The teaching materials were administered as part of two teacher PD workshops. The first workshop was conducted online via Zoom conferencing. The second workshop was conducted in a hybrid format, where the in-person element was conducted as part of a learning science conference workshop, and we hosted a Zoom room to accommodate teachers that were remote. In order to make participant interaction and collaboration smooth, we utilized the Owl conferencing camera and large screens for remote participants' audio and video interactions. Both workshops were advertised through teacher networks, CS/AI/Art K-12 educators' and learning science researchers' mailing lists, and on social media. Both workshops were open to formal and informal educators, researchers and curriculum designers who were interested in developing learning materials for or teaching generative AI in K-12 classrooms. Since the goal of the workshop was to develop and teach learning materials for K-12 classrooms, for the purpose of this paper, we will refer to all participants as *educators*. Both workshops were 6-hours long. While workshop-1 was conducted in 4 different 1.5 hour-long sessions, workshop-2 was conducted in a single 6 hour session. Pre and post-workshop surveys were conducted to record participants' perception of generative AI, their familiarity with generative AI tools, and their attitudes towards them. Consenting participants' emotions around AI-generated art were recorded using Padlet<sup>6</sup> boards.

### Participants

28 educators participated in the first workshop, and 23 instructors in the second workshop. Twelve participants in the first workshop and 18 participants in the second workshop provided informed consent for their data.

## Findings

### Introduction to Generative AI in Classrooms

The introduction session gave educators an overview of TTIG tools, their applications in classrooms and their societal implications (LO 1.c, 3.a-d). Teachers shared how generative AI can be used by students to visualize future careers or as collaborators in art lessons. When asked about the content that they would like their students to know, the following themes emerged: generative AI is biased; the responses are not always correct; which tools they can use for free; data security; writing good prompts (LO 3.a, 4.a).

### Exploring Text-to-Image Generation Tools

Participants in the first workshop were administered Assignment 1: Storytelling with generative AI and Assignment 2: Designing a self-portrait. In Assignment 1, all participants successfully used TTIG tools and engineered their prompts to create desirable visual media for creative storytelling (LO 1.a-c). Participants shared strategies that they discovered with one another, for instance, using previously generated

<sup>6</sup><https://padlet.com/>

images as input prompts in addition to text prompts to get a uniform style, or sharing prompt modifier keyword ideas. Participants started with simple natural language prompts, but soon started adding prompt modifiers to indicate desired tokens such as style or weights (LO 1.b).

In assignment 2, participants created self-portraits. Educators Helen<sup>7</sup> and Jayden noted how AI-generated portraits made them "more White" than what they expected. Educator Max noted that when they used "non-binary" in their prompt, the image would get censored. Educator Zeynep noted how people of color needed to add a lot more identity detail in their prompts as compared to their White colleagues. The researcher prompted educators to discuss why this difference in interaction must be occurring, and educators recalled that this may be a result of more White faces being a part of the training dataset used to generate the portraits. Learners identified biases reflected in AI-generated images (LO 3.a), and discussed imbalanced training datasets (LO 2.a).

Upon further discussion with educators, we decided that the portrait activity may be harmful to K-12 learners belonging to race, ethnicity and gender minorities and replaced this assignment with Assignment 3: Generating Dreams for workshop-2.

In assignment 3, participants successfully created imagined futures for themselves or the world. Some educators recognized differences in AI and their own visualizations. Cathy was attempting to visualize, "bringing together people of all ethnicities, gender, age and ableness" where she desired to create a diverse group of people, but the AI generated a person holding a protest board. In constructing dreams too, participants recognized algorithmic bias. For instance, Sejal expressed how she was imagining herself as a doctor, but it would show a man by default.

### Designing Learning Activities for K-12

26 educators engaged in groups to design a total of 19 learning projects for K-12 students which involved identifying stakeholders, and designing and sharing prototypes (LO 4.c). Target learners chosen were: Mix of ages (2 teams), elementary school (4 teams), middle school (7 teams), high school (7 teams), and university (1 team) students. The learning goals chosen by the educators included: Creative writing using generative AI, Auditing algorithms, Communicating new AI models, Identifying bias, Ideation with AI, Imaginative Creature Design Iteration, Generative design, and Geometric shapes (LO 4.a). Educators chose topics that were relevant to their teaching or research areas, thereby applying the concepts they learned in the workshop to their area of expertise and practice. They also chose a wide range of pedagogical tools, including, games, structured activity, debate, curriculum, and interactive tools (LO 4.b). Seven projects addressed algorithmic bias concepts integrated with AI learning (LO 3.a). We present one illustrative learning activities or tools designed by educators in the workshops.

### E-DIOMS: Introduction to Text-to-Image Generation for K-12 Education Using Games Target Audience:

<sup>7</sup>names altered

Rate your Familiarity with Generative AI: Pre vs Post Workshop

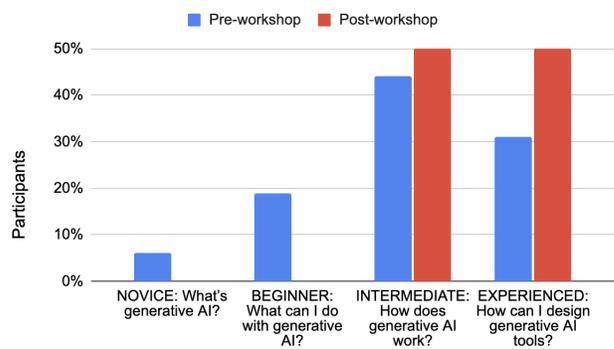


Figure 2: Participants' self-reported levels of familiarity with generative AI pre and post workshop

Middle school students.

**Learning goals:** 1) Learn about Text-to-Image generation possibilities 2) Discuss the limits of 'knowledge' of Generative Models and 3) Engage students' in both CS + English/Literature contexts.

**Pedagogical method:** Multiplayer digital game

**Description:** E-dioms engaged middle school students in Computer Science, English Literature and cultural learning about idioms through a multiplayer interactive game. A host chooses a target idiom. One player generates an image from the target idiom, and the other player guesses the idiom. Players are prompted to write an idiom that their classmates understand but the Generative Model doesn't. This helps them understand the limitations of TTIG algorithms.

**Teacher Reflections:** Participants' reported confidence levels towards using and understanding generative AI showed a positive difference between the pre-survey (n=15) and the post-survey (n=10) (Figure 2). Participants demonstrated stronger beliefs in the potential of these tools to perform creative roles in K-12 learning and instruction.

### Conclusion

In this paper, we contribute learning goals for teaching educators about TTIG algorithms. These can be extended to teaching other socio-technical AI systems. We suggest a co-design approach with teachers, where they not only learn about a novel technology, but create learning materials, tools and curriculum around it. Finally, we contribute learning materials to teach TTIG algorithms to non-technical learners, which can be used for other professionals and K-12 students. Through two user studies, we find that educators used these learning materials to demonstrate an increase in confidence levels for performing the tasks above that ultimately empowered them to design image generation applications for K-12 settings. They also drew inspiration from each other's designs and discussion points. Educators in our workshops leveraged their unique expertise and prior teaching experiences to confidently tweak existing generative AI curricula to cater to diverse student needs and backgrounds.

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