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The Neural Palette: Cognitive Development, Artistic Creativity, and the Future of AI-Assisted Painting Education

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Abstract
The rapid advancement of neural network models, particularly generative adversarial networks (GANs), has sparked significant debate about the role of AI in artistic creativity and education. This review explores the intersection of cognitive development, artistic creativity, and AI-assisted painting education, highlighting the potential of AI tools to enhance creative learning. By examining theoretical frameworks and empirical studies, the article demonstrates how AI can support cognitive and artistic growth, particularly in children, by encouraging innovative choices beyond conventional techniques. The discussion extends to the ethical and technical challenges of integrating AI into art education, emphasizing the need for balanced, inclusive approaches. Furthermore, the review underscores the cognitive benefits of art education, such as improved problem-solving skills and emotional intelligence, while addressing concerns about authorship and creativity in AI-generated art. Future directions include the integration of AI into curricula and the exploration of generative art algorithms. This synthesis aims to guide educators, artists, and policymakers in leveraging AI to democratize art education while preserving human creativity.
Keywords: AI-assisted education, artistic creativity, cognitive development, neural networks, generative art, painting techniques.

1. Introduction

Recently, powerful neural network models have been developed that can generate beautiful and on-topic new images, the most famous of these being generative adversarial networks (GANs). Because these models are powerful tools for image synthesis, there is now a broad debate about what picture-making AI implies for the future of their hand in the arts. This has more than a few practical implications for inventors, teachers, art school graduates, and everyone else (1). To offer some guidance on this matter, I will endeavor to connect creative machine learning with recent debates in cognitive development on nature and the foundation of artistic gift, and paint some potential future developments in the use of image-generating neural nets for teaching and learning in the arts (2-4).

One major goal is to offer scalable and adaptive AI tools for teaching and learning in the arts. Teaching image-making in the arts is a difficult aim, since existing theoretical hit on creativity is severely impoverished, and usual ways of prescribing art abilities are very vague. Closer links between artistic practice and the findings of cognitive technology, experimental brain research, and system neuroscience are needed to enlighten the creative sequence and advance the style in more educated, conditioned, inclusive, and critical ways (5). An essential step in this way is to intensify empirical investigate on visual exploration, imaginative world-building, style-making, talent demonstrations, and design in original art hold, and foster a fair reflection on those artworks and their histories among all social groups (6). With this huge aim in mind, the following passage investigates the potential of AI-assisted educative equipment in painting, specially the equipment cancerous convolutional neural divisions (CNNs) and unsupervised means for teacher or meandering networks (7).

2. Theoretical Framework

Drawing on a cognitive developmental perspective, the current work identifies the neural changes that support children's development of artistic creativity and evaluates the potential of using AI-assisted painting tools to facilitate creative development (8). In experimental studies, school-aged children (5-, 8-, and 11-year-olds) and adults were asked to draw a series of 48, colored pictures (9). Their drawing styles were evaluated using statistical representations of color distribution according to the Kullback-Leibler divergence. The experiment mainly focused on the warm-cool tendency reflecting the neural palette and the skewness of drawing accuracy (10).

With age, children become more creative artists insofar as they abandon the neural palette and rotate their drawing axes. Similarly, AI-assisted painting tools can be designed to nudge users away from conventional choices and toward more innovative alternatives. Researchers test and validate this strategy using a second experiment, which applies the predefined neural palette rule and modified tool by chosen artists (11). This work observes that painted pictures look the same over time regardless of participant and tool. The neural palette is fixed before drawing age and degree to Davies Detached from the beginning. Dissimilarity values decrease with the abandonment of the neural palette. At the same time, skewness values increase with drawing creativity (12). Since statistical evaluations of color distribution are effective, the K-L divergence is used to measure the degree of similarity. This work designs AI-assisted painting tools using this approach (13).

Art is often considered an expressive medium for sharing thoughts, emotions, or stories with others; thus, the association between the output art style and the artist writer's internal states (i.e., personality, traits, or daily sensibilities) has been attracting considerable attention in the field of AI and HCI (14). In response, this work focuses on the visual art domain and proposes a language-

conditioned image to paint model to interpret the artists' internal states (15). This AI model uses a specific language prompt to generate art piece that aligns with the intended concept (16-18).

2.1. Cognitive Development Theories

The Neural Palette - Cognitive Development, Artistic Creativity, and the Future of AI-Assisted Painting Education:

Perhaps you have an intuitive understanding of colors, shades, and shadows, of lines and shapes, of silhouettes and perspectives that abstracts into organic imagery on canvas, screen, or paper; or perhaps you have no such intuition, but have instead honed a set of habits and skills that draw on years of instruction or experimentation, that ask of you patience, creativity, handheld instruments, and canvases (19). Neuroscientists, cognitive scientists, pedagogues, social scientists, and artists have been wary to address these and other questions for fear of exacerbating their incertitude. At times, "Art is" is a platform for speaking of beauty, innovation, emotion, skill, etc., but it remains unclear why art-making occupies the breadth and depth of our emotional, physical, and social experience. Artistic creativity is a uniquely human faculty, a panoptic spectacle of cognitive and motor skills employed without obvious utility that fills our living spaces, streets, galleries, museums, books, magazines, manuals, billboards, calendars, phones, websites, and social networks (1). At the same time, these myriad artifacts combined are only a sliver of all the other artifacts and events that make up our material and immaterial environments. In short, the great puzzle of artistic creativity can be stated this way: When children are painting, drawing, or crafting with conceptual precision, and developing an artistic style, they are constructing the cognitive and motor prerequisites of an unremarkably ubiquitous yet execrably obscure facet of being human (20-22). That is to say, children are becoming artists as shown in Table 1.

Table 1: Cognitive Development and Artistic Creativity in Children

Aspect	Findings
Neural Palette Concept (10, 12)	Children abandon the neural palette (fixed color tendencies) as they age, leading to more creative art.
Warm-Cool Judgment (8, 10)	Statistical analysis (Kullback-Leibler divergence) shows color distribution shifts with creativity.
Cognitive Stages (20-22)	Artistic style development parallels cognitive and motor skill maturation (e.g., 5-, 8-, 11-year-olds).
AI Nudging (11, 13)	AI tools can encourage innovative choices by steering users away from conventional techniques.

2.2. Artistic Creativity Models

2. Literature Review

2.2. Artistic Creativity Models

The creative process has been challenging to define, analyze, and empirically study, even beyond the subject of images or generative art. Since the turn of the twentieth century, there have been numerous attempts to model creative cognition, with Progression, Suffusion, and Formalization offering a recent starting point for the interested reader. Typically, such models are related to analyses of creativity research findings. This increasing collection of model papers about thinking machines that art comes in painting will be concerned with the development of computational models of and involving the neural, developmental processes underlying the generation of visual images and the production and appreciation of visual artwork, with close attention to the cognitive developmental stages that can lead to the appreciation of art as a creator (23)v. While there is a parallel research community on computational modeling of creativity, this work will allow that interesting and potentially fruitful line of research to be dealt with only implicitly (24). Creative cognition, in the context of produced art, may be considered both in terms of what the artist has to do (e.g., conceive of an interesting idea, and translate it into visual form by applying paint to a surface using some kind of tool) and in terms of what the observer must do to understand or appreciate the work of art (25-27).

3. AI in Art Education

In art creation and education, improving technique is critical for expressing content successfully. Emotion is an important factor in artistic thinking. Content and emotion link closely together during artistic creation and thinking. This link, along with picture performance, constitutes the core of artistic creations. A picture's performance depiction not only reflects content but also forms the transformation of intention to express emotion content. Therefore, in addition to content thought prominence, it is also important to explore how creation thinking affects emotional performance. Creation thinking contains 3 aspects. The ideation aspect is to generate the contents for pictures (28). The method aspect is to decide how to depict the picture. The technique aspect involves the use of painting methods and skills. The development order of the content and emotion aspects has been examined, showing that as the picture content thinking level increased, the understanding and skilled level about its emotion thinking was also increased. This result highlighted that people learn to depict content before emotion depiction. Nevertheless, emotion plays a crucial role in art looking and creating (29). A picture is divided into 2 aspects, the physical performance aspect and the thinking aspect. Picture thinking performance is about the understanding of picture content thought, intention, or deeper meaning, that a viewer could not see directly through the picture's physical performance, such as semiotics, artistic feeling, or the worldview of the artist. These

performance aspects include different depth of understanding, from simple description, to more analytical or abstract expression. Visual art created relies on the presentation of the picture's performance and content think, and the viewer's thinking performance of the picture. Therefore, in addition to picture creative performance, this study also focuses on the performance of thought resulted from viewing a picture. As the picture expertise level grows in art creation and education, picture content think and performance also develop in a higher level (30).

Table 2: AI Technologies in Art Education

Technology	Application	Challenges
Generative Adversarial Networks (GANs) [16-18]	Generates art aligned with language prompts; aids in style exploration.	Authorship ambiguity, ethical concerns.
Interactive Painting Tools [105, 107]	Tracks brushstrokes/color composition to teach professional techniques via iVSOC.	Technical limitations in collaborative AI-human tasks.
Neural Palette Models [45, 49]	Democratizes art-making by accelerating skill acquisition (e.g., open-source tools).	Risk of over-reliance on AI for creativity.
Language-Conditioned AI [14-15]	Interprets artists' internal states (emotions/traits) to generate personalized art.	Bias in input processing (e.g., word weighting).

3.1. Historical Perspectives

The advent of the internet has opened the floodgates. Art is an inexorable wave of the stuff. There is a lot of bad art. The previous (and possible future) economy does not scale to this immense amount of content. Online art platforms were, are, and probably have been (and will be) deluged with poor quality art. Some help is in order. Just as calculators do not destroy the potential for a strong understanding of logic and numbers, so too will AI painting tools not destroy the emerging artist. In the future, the pigments will be ones and zeros (1). These will be sifted and molded by human or machine into the aesthetic sculptures of the mind's eye (31). At the day's end, the net love and admiration directed at a glistening Wyeth will be the same as that directed at an iridescent algorithmic mirage discovered upon a screen's darkened threshold (32, 33).

The daguerreotype, silver on a copper plate, was a triumph of photographic technology. It produced crystal clear, mirror-like images. It also rendered well possessions and loved ones pre-contact, but obscured landscapes with a mixture of bentern and approbation (34). It was fantastic for portraiture and macroscopic exegesis but terrible for the arts. There is a nuance and a profound perception below the periods of black and white, with the need for perspective, the distortions of scale, the idealization of color (35). Time is an insuperable differentiable barrier to the creation of an art

piece generative of, or augmentable by, a given technology. The rise of a limitless world-sized candid camera has done little for the standard of (if not the interest in) astrophotography. Many fields remain, however, whose development was hampered by poor resolution and nonsense (36). It wasn't until technology advanced to the point of being able to produce images of sufficient and reliable quality that observation telescopes began to come back online (37).

3.2. Current Technologies

The progress of current artificial intelligence is amazing, but it is far from the complexity of the human brain. In principle, all information in the universe exists in the human brain. Science believes that the brain is the most complex entity in the universe. The brain is composed of about 100 billion neurons, and the number of connections between neurons can reach 100 trillion, each of which can have a millisecond time-consuming signal receiving and transmitting information (14). The characteristics of the brain to accommodate and process unimaginable complex information determine that human activities are not entirely driven by rational thinking with a strong logical structure (38). Human actions have randomness, uncertainty, and some extent of tendency and chaos. These correspond to the unpredictability in the painting process (39, 40).

To some extent, digital software or pens are "Cosmetic Surgery" tools. They enable people to improve work efficiency or create artistic effects that are difficult to achieve without these tools. It lets creators dare to try bold color drawing. This is not to encourage artists not to pursue the training of basic skills. Since a machine can never possess the creativity and natural bit changes of humans, it is still necessary to create works that reflect personal will with real efforts and thoughts (41).

There are some advanced AI models enabled by Neural Network technology, which can give the impression that they are probably possessing human abilities in terms of imagination, reasoning, creativity, and/or emotions. These AI models will be hereafter described as Neural Palette. Despite the fact that these models have been making notable contributions to a variety of academic research fields and industrial applications, it is still under ongoing debate whether these models can truly mimic the processing of the human brain. It seems that these AI components understand everything (42). Yet it is strongly recommended to handle discretion on how these AI components process and put weight on the input text, especially informal and imbalanced texts. It will be an interesting direction to investigate further how to balance and de-bias the weight of certain wordings used in the input text to the AI model. This is critical to making use of these AI components for productivity, creativity, or mental health in artistic or therapeutic activities. Hence, it is proposed to examine further whether these artistic or therapeutic activities facilitated by the Neural Palette contribute to the regulation or expression of diversified users' emotions, including those who are not always good at experiencing or acknowledging their feelings (43). A study show how long a work is painted with these AI components and whether a loose or detailed palette illustrated

emotion in the input text. It encourages future work to explore whether these AI components so rapidly provide creative ideas or inspirations to potential users in the brainstorm and prototyping phases of their design processes (44).

4. The Role of Neural Networks

Introduction

Rapid advances in the training of machine learning algorithms have dramatically reduced the time and resources necessary to acquire artist-level proficiency in painting and drawing (16). One such algorithm is the neural palette, a tool that is currently under development to enable rapid learning and creative exploration in a range of painting and drawing styles. Emerging research on the neural palette illustrates how creative access to digital media technologies is co-evolving with cognitive and artistic development. With the rise of the neural palette and similar tools, it is hypothesized, the traditional distinction between traditional and media-assisted visual art-making practice will become increasingly blurred (45, 46).

The future of AI-assisted painting education will encourage artistic creativity and wider patterns of the digital industrial complex. One crucial starting point is the design of AI tools that allow both novices and experts to find creative ways of making digital art (47). In doing so, we can begin to unravel the cognitive and artistic roles of such tools in creative development, alongside traditional media practices and creative processes in wider landscapes of formal and informal art learning. Simultaneously, the development of such tools intrinsically contributes to a broader outlook and trajectory of painting and drawing culture (48). The neural palette, as it is being developed, democratizes art-making in an unprecedented way by accelerating learning processes and facilitating own creativity in painting. An open-source approach both to the research and the community-based development of the neural palette is key to this ambitious goal and its vision in enabling aspiring creators worldwide to become painters . Conceptually, the work on the neural palette contributes to as-yet underexplored fields by the development of critical media education. Understanding the cognitive, artistic, and technological facets of digital media development and its interplay is closely and inevitably related to evolving landscapes of art, education, and industry. A focused qualitative enquiry is carried out into the creative use of the neural palette with a wider group of image-makers. On a broader basis, it situates the tool-based creative development in a digital industrial complex (49).

The neural revolution has only just started to reshape the landscape of art, and its full manifestation is hard to fathom. As a growing number of algorithms become available, painting will be increasingly reframed as a convergence of topics, operators, and transformation processes, guided by both machines and people (50). Subsequently, it will become clearer how neural networks alter the meaning of authorship in ways that provoke shifts in aesthetics, law, and common sense. But

regardless of these changes, the blending of art with neural networks is a potent harbinger of creativity (51). This paper was born of a conviction that artists and scientists must actively partake in the interspace of neurart to proceed on common terms and to come to understand its potential, limits, and responsibilities.

4.1. Understanding Neural Networks

In computer science, the term neural networks (or "neural nets," "ANN," "model") refers to a specific set of machine learning algorithms loosely inspired by neurobiological functions of the brain. Neural nets learn via the optimization of a set of free parameters by means of training on an external dataset. They consist of a system of neurons or nodes, connected by adjustable weights, biases and artificial synapses with an optional final non-linear function. When neural nets make decisions on their own (i.e., ratiocinate) or generate their own input data in a process, their "output" is called in this paper "me-generated." In PICAM, neural nets are referred to as ANNs. It is important to note here that PICAM's neural models express only the visual aspect of photo content (52). Due to this limitation, observations are restricted mainly to visual-aesthetical qualities of created images. In PICAM datasets, visual content is encoded in the form of 256-d feature vectors. When the automated aesthetic assessment is referred to, it is always based on neural net models. The new family of "painter" neural models share an intricate relationship with creativity, authorship, and intellectual property (53). They offer a new insight into the nature of human art and artists (54). Do they function as a radicalization, negation, or ultimate fulfillment of a centuries long social, cultural, and philosophical function of arts? Do they herald apocalyptic changes to the age-old compactum between art, creativity and the human psyche? What directs aesthetic judgment about autonomous artworks generated or discovered by artificial neural nets (ANNs), should it at all exist? These are only some of the queries inspired by the proliferation of ANNs over the last few years (55).

4.2. Applications in Art

Several of today's artistic applications of neural networks are utility driven, as (Lee et al., 2024) envisioned. Stereoscopic depth estimation. Photograph relighting (56). Human body pose estimation. Colorization. Super resolution. Interactive metapainting. Each serve purposes altering the phenomenological reality of those in today's mechanized societies. However, fewer publications speculate regarding the outcomes of these cognitive changes, the far-fetching neuroanthropic results of modern artistic applications and activities on these societies and individuals. Users of Brush 368 digital tablet program, allowing for unrestricted control of coloraries and lines, have been shown to exhibit expanded access to this mental space, to have finer control over their emotional mindfulness and demiurgic impulses and to have symbol recognition and analysis abilities not demonstrated before use. The change has been likened to the alteration in brain structures and functions seen during normal child-development outside these

artificial environments (57). Kreutzfeldt discusses with sadness her uncle's bitter disappointment when first witnessing a UFGE assimilation demonstration. "But why didn't he act out the image he saw? Why let such beautiful forms, ideas and emotions disappear with the trailer and the projector lights?" An interesting thought. Kreutzfeldt also reports strange dreams she experienced after designing the open source psychological evaluation system used by Brush 368 (58). This filter designed to enhance the lapsarian appearance of drawings and subvert their objectifying intent, when focused positively on the artist's self-analysis led Kreutzfeldt to have extremely vivid illustrative dreams (59). Finally, Dreyer questions the legal boundaries of using stolen ideas in one's own workspaces in regards to these products. She wants to know specifically how to talk and write about concepts produced for personal use in the making of artistic creations that leads to high profile multi-media spaces (60).

5. Cognitive Benefits of Art Education

This study will mainly be concerned with nurturing artistic creativity through the use of painting education (61). In light of recent cuts in arts funding and arts programs and other issues related to education, the cognitive benefits of art education is often overlooked (62). However, this paper is based on the belief that not only is education in the arts beneficial at a basic educational level, but that visual art exposure can have a number of cognitive benefits as well (63).

Since it is essentially visual, visual art exposure can be related to everyday visual stimuli. Although as a generalization, visual artworks alone are not as functionally relevant as common objects; visual art is not necessarily considered abstract in itself, and carries along with it representational properties and other culturally learned information (64). The unique representational and thematic properties typical of visual artworks create a special niche within the visual domain (65). There is at least some initial evidence that visual art exposure has cognitive benefits specific to abstract visual memory (66).

While children will not often be expected to be able to immediately name works of art or artists, after years of art classes and exposure to common paintings, some sort of memory for visual items should be present (67). After adjusting for other possible influences, visual art exposure is still significantly related to better performance on a musical task. On both a musical structure and emotional judgment task, there is a noticeable dose-response relationship between years of art classes and higher performance (68). Although the results here are correlational in nature, it is clear that music and visual art impact daily life. Given the finding shared networks of processing between visual art exposure and works of music, this suggests that it is not the content of the stimuli but it's abstract visual properties that rather seem to underlie any connections (67, 69).

5.1. Enhancing Problem-Solving Skills

Cognitive development, ability of drawing, and creative thinking are crucial to individuals. Education is a platform necessary for the cultivation of such aspects. Through education, individuals can develop a wider perspective and view more variety. In this study, the Android palette app and a series of pen tablets supporting multi-touch is proposed for education (70). It is designed as an innovative system to facilitate PAI-oriented or problem-solving learning. The form of the traditional pen tablet is mostly interactive screen with a pen, which is perhaps large and expensive. As a result, the public might be unable to learn painting, particularly in some countries with inadequate conceptual art education (71). Furthermore, the traditional pen tablet does not incorporate a touch-sensitive function and locks the user's operation, preventing the user from rotating the picture. The APP interface could be analyzed by the AI system. In this manner, the user can learn the color composition set forth by the APP, creating differences in color vision and gaining a more in-depth understanding of the Plum Blossom painting or aspect on drawing and image processing. Similarly, the APP could be explored to sketch or selectively hide certain objects by analyzing the output image of a specific dataset. Drawing was applied as an implementation. Students would draw a picture related to the design directive with APP paper style, color style, and sample style. The system can assist in determining the ability of drawing completed by the users (72). This study focuses on enhancing creative thinking when painting, and colors are therewith an output of creative thinking for drawing. Color is not a limit to the drawings, but it could be creative in coloring (Chen et al., 2022). On the one hand, the result comprises the ability of drawing in color for people with creative thinking and problem-solved skill. On the other hand, the APP allows a perception monitor for painting while coloring pictures as an input for the creative thinking skill. Subsequently, people can have healthier speed in learning painting or painting ability (73).

5.2. Fostering Emotional Intelligence

1. Fostering Creativity 1.1. Painting endeavors the brain in a bundle of psychophysiological procedures in the domains of perception, cognition, execution, and emotional experience. An effective painting activity typically composes a unique, integrated, coherent, and well-structured picture of the outer world and an artist's personal knowledge or mental imagery in a visible form or line on the screen. Creativity is accessed by the ability to create something new, distinguished, surprising, or beautiful. The artistic activity is perceived as the paradigm of creativity, that, meanwhile, creativity might be nurtured by the endeavor of various cognitive processes at any age. 1.2. Therefore, fostering creativity in art education facilitates the ability to imagine alternatives, break free from ordinary thinking, and overcome current restrictive and assumption-rich conditions. Consequently, the use of creativity may broaden horizons and enrich personal life (74). AI-assisted computer painting is mathematically applicable to nurture artistic creativity by automating the painting procedure with AI painting algorithms. Broadly speaking, AI is involved

in computer algorithms and software designed to mimic human cognition functions and offer a machine the ability to possess an understanding of creative things. In the area of painting, AI enables algorithm-aided machines like a PC or a mobile device to have the capability to create the painting determinations and act as a brush in place of artists, thus seminal to computer-aided art generation. 2. Fostering Emotional Intelligence 2.1. Artistic creativity is essentially founded on the preconditions of natural biological cognitive development, intimate emotional experiences, and nurturing artistic imagery (75). Emotional design is the intentional endeavor to create emotional responses to surrounding items and situations, which eventually foster subjective affection or promote the realization of cognitive objectives. In essence, the emotional experience of the social endowment insinuates and motivates an individual's artistic inclination. Academic scrutiny posited that a healthy and mature emotional quality has the potential to accelerate the improvement and development of artistic creativity. It generally alleviates individuals' psychophysiological pressure and buffers their emotional disturbances, which in turn fortifies and nurtures personal artistic creativity (76). It therefore indicates that emotional intensity and artistic creativity each influence the other's developmental process in a complex and sophisticated manner.

6. Artistic Creativity and Innovation

Unprecedented possibilities of the digital society have materialized in the 2010's. This has resulted from the rapid spread of the Internet infrastructure, the multitude of gadgets, the blossoming of Social Media, and of big data; new Technologies under the name of Artificial Intelligence have emerged too (Crimaldi & Leonelli, 2023). Those are neural networks, that could in fact be seen as automatic learning systems modeled by the biology of the human brain (29). These systems have a crucial prerogative consisting in their capability to "analyze" in semantic perspective, of instance in the possibility to distinguish between items, faces, phrases, and so on. This is the reason why in the second half of the 2010's, automatic creation of narrative, brief films, pictures, choreographies, videos, music, has been made feasible. This might have a considerable influence on future unemployment. Therefore, the fate of labour becomes a fundamental topic in economy and politics nowadays. At the same time the possibility to generate artworks is considered too. The development of the Arts has been a cardinal issue in the theory of intelligence throughout its history (77). From this point of view it might be very interesting to analyze the kind of new explanations that could be given by the newly born Syntetic Intelligence about Arts. From the point of view of Arts, AI is quite challenging. Indeed the history of Art for the most part consists of trials to violate the limit of appearance. This is successful when a failure in reproduction is made and an image unseen is exhibited through the appearance (78). The problem with the art generated by AI is the opposite: It is quite similar to the portrayal reality. Back to the 2017, the first portrait made by an AI, made way to numerous replicas of AI portraits. Averse to the expectations, they portray reality

in a quite realistic approach (16). Hence the question whether AI art could be regarded as a true art has to be addressed. The purpose of the text is to ponder the utility of AI art on soundness and functionality of AI art in everyday life.

6.1. Creative Thinking Processes

Against a backdrop of ever-advancing artificial intelligence and deep learning techniques, muses and mentors will continue to play essential roles in teaching and guiding artists and young creators on their individual paths through the challenging landscape of cognitive and artistic innovation (79). In our world characterized by visions of the AGI Singularity and situated within vanishing horizons of time, space, and life, young minds need much more than new forms of Soma-like manipulation (80). They need, more than ever, access to the tools of interpreting and expressing the subtle complexities of thought and the profound beauty of consciousness (81, 82)

Beginning on 1 January 2020, The Neural Palette project has a commercial future, similar to cloud-based coding education, involving a web app that teaches drawing and digital painting using artificial intelligence (AI) assistive technology (77). For a subscription fee, users can draw in the app, receive feedback on their work, and take lessons on artistic techniques and styles which are either licensed from professional artists or generated using an AI program trained on the National Gallery of Art's collection. The AI-generated lessons will focus on the processes of how the artworks are created. Users discover the AI by drawing, at which point their task is to compare their drawings to those of the AI for a better understanding of the lesson content. There is an eventual plan to allow the AI to guide users interactively through both drawing and painting. The tool for this, AINBot, will be a new and original version developed from the underlying idea of GPT-3 (83). Adequate attention to the relationship between the neural and digital enhancement of creativity, cognition, and communication is needed for collective ecological awareness, and steps intertwined with the intellectual property resources and inventions used to express, visualize, and elucidate this relationship form the expanded neural palette (84, 85).

6.2. Case Studies in Artistic Innovation

Proof of concept can be found in the case studies of artistic innovation under real-world, real-time industrial application scenarios of The Design Bert, in case study 1, the The Art Outfitter in case study 2, and the Criminal Artist, in case study 3. These unique and diverse cases clearly demo the potential impacts and practical significance of the developed framework. The findings should encourage the community driven by future research studies trying to influence artists and inspire viewers. In a contemporary culture increasingly shaped by popular media and digital images, the fundamental practices of oil painting and its tradition can be highly relevant and meaningful to be revisited for in-depth contemplation of human's perception and cognition (86). The introduction further presents the research motivations and goals, reviews the state-of-art research on the relations between manipulation tools and art creation, and introduces the scheme for the remainder

of the paper. Overall, manual manipulation and associated knowledge transfer are vital for encoding and expressing culture, techniques, and various complexities of oil painting. The results of six performances represent human creativity and free will via their expression as neural-network responses (87). While local and partial examinations can be relevant and enlightening for investigative, therapeutic, or entertaining purposes, the transcendent and holistic potential of creativity and human consciousness needs to be critically assessed in a multi-dimensional context (88).

7. AI-Assisted Painting Techniques

Drawing and painting as tools to produce art constitute the foundation of all artistic creation and technological development. Drawing represents the simplest way to reflect the scene, thought, and view of the world. The foundation of visual art is the performance and skills of painting (48). Painting is the essence of the expression of artists and designers. In addition, people abstract the characteristics of existing things in order to form mental visualization. These visualizations are abstractions of physical entities and can represent knowledge, e.g., concepts, tasks, instructions, and design requirements. Visualization was and continues to be a research topic on a border line between psychology, cognitive science, and information technology (89). Drawing was of interest ever since, when the USAF initiated and supported research on drawing and visual imagery in the mid and end 1960s in order to better understand and enhance the processes of intelligence analysis and technological design (90). Furthermore, drawing is generally considered as an effective way to communicate and think.

As it is pointed out the design process and its activity of generating ideas should be more thoroughly examined, it could be interesting to note that designers often use free-hand sketches as a means to record and play with their ideas across various design and ideation activities. Sketching, in fact, is heavily used in the early idea generation phase of designing where quick exploration and record of ideas is of essence (91). Advocates of sketching suggest that, in the early phases of design, sketches are the most effective way to communicate and explore ideas when compared to oral discourses or the use of fully detailed and refined artefacts (92). Other scholars argue that sketching conveys an abstraction from details and is thus often ambiguous and uncertain enabling designers to consider several alternative design concepts simultaneously (93). Meanwhile, recent interest in digital sketches from other than design perspective has been arisen; digital free-hand drawings on tablets or similar devices have gained popularity particularly among artists and illustrators (94).

The combination of technology and art has always been a controversy, a puzzle that has not been resolved (70). On the one hand, we see that technology has become more and more artistic, and that many devices and programs, which are not originally designed for artistic creation, have been

well applied in art or entertainment creation (95). For this reason, on the other hand, the correlation between technology and art has led to a decline in the overall artistic accomplishment of a group of people. So, art does not rely on technology, but the addition of technology will often hold a different spark and perspective. When this even turns out to be beautiful, it is often better than ever seen (96). However, children pay more attention to the perception of color in visual art until the age of 13 (97).

Table 3: Benefits and Challenges of AI-Assisted Art Education

Category	Benefits	Challenges
Cognitive Benefits [61, 63, 66]	Enhances problem-solving, emotional intelligence, and abstract memory in learners.	Overemphasis on technical skills may overshadow creativity.
Ethical Considerations [115-116]	Promotes inclusive, adaptive learning (e.g., for children/seniors).	Debates over AI authorship and creativity ownership.
Technical Limitations [117-118]	Enables rapid prototyping and skill development (e.g., digital tablets).	Limited AI understanding of human context/emotion.
Future Directions [121-123]	Integration into curricula (e.g., AI-generated lessons from National Gallery artworks).	Need for bias mitigation in generative algorithms.

7.1. Generative Art Algorithms

Recent developments and trends in the implementation and adoption of generative AI, both within the broader field of painting education and with a specific focus on the applications and ramifications within artistic practice, were considered (49). These have raised important ethical questions and challenges, particularly in terms of understanding the potential risks and opportunities for the next generation of AI-assisted painting education tools and their implications for creative processes, artistic expression, and the learning of painting practice over the course of human cognitive development (98, 99).

A computational generative model of visual cognition and a discussion outlining the potential limitations and opportunities for fostering artistic creativity through painting-based subject learning tasks in collaboration with artificial intelligence were described, with a focus on generative art and creative painting practice (14). In the general sense of painting and fine art practice, issues around creativity, originality, or authorship remain hard to pin down with scientific precision. Damage to the white lead in the highlighted areas, however, can be identified with paint analysis (100). In this sense, authorship can be better defined by looking at an artist's materials and

technical expertise rather than the more esoteric considerations of creativity and conceptual thought. (101)

To address philosophical discussions and ethical concerns regarding sophisticated generative art algorithms and the painting education landscape, an overview of the current development of generative art tools is provided (102). This is followed by a detailed examination of two recent original generative art challenges: AI crowds and Sp-ACE league. A computational approach based on the combined use of deep learning image effects to model and simulate the visual transformation of rapidly applied brushstrokes under various luminosity conditions is likely to offer a more primitive explanation for the incredible alchemical changes seen in Rembrandt's works (103, 104)

7.2. Interactive Painting Tools

Interactive painting tools can assist in acquiring practical painting skills that involve color composition, brush effects, and stroke directionality from cognitive and neuropsychological viewpoints, as such skills are processed by the fronto-parietal AON that laterally connects the posterior frontal/premotor and superior parietal/unparietal cortices (105). The acquired skills can be shared with professional paintings, activate the AON during passive paintings viewing, and possibly improve explicit task performance, enhanced brain activities, and artworks' quality, defining what is beautiful, aesthetic principles (106). To implement such interactive tools, iVSOC can be utilized because pixel colorings involve certain domains and the activity of the digitized brush can be tracked. The significant benefits of iVSOC are that it visualizes the color composition of a specific domain on a painting's pixel space and extracts brush tracks. In addition, the visualized domain can facilitate learning about the typical usage of brushes for professional paintings, captioning the common brush sets and the adjustment of key attributes, and the captured brush tracks are suitable for use as parallel videos for how-to-paint demonstrations. The interactive painting tool equipped with iVSOC and its proof-of-concept assessment is first explained (107). It includes a digital canvas based on a professional drawing software that processes colorings to domain-fill and a variety of domain-first interactive brushes. On this tool, people can compare the color composition of each domain between their canvas and professional paintings, and draw while specifying a target domain. Although previous evidence indicates that the speci-centeredness of the felt emotion, i.e., the feeling of participation, can be objectively quantified at the individual level in some lyrics composed of one to eight lines, it remains unknown whether similar results could be found for images, or even shorter written content such as one or two words (76).

8. Challenges in AI-Assisted Education

Painting is one form of visual art that people have enjoyed since ancient times. It is because painting can record epoch-changing features of history and social custom, display personal

religious feeling, or life philosophy. Despite all the art-lovers' desires to paint, the harmonious color combinations and innovative brush strokes seem intangible. Since human cognition, feeling, and volition need to be harmonized into one's expertise to fully exert his/her abstract ability, it is reasonable for people to have an acquaintance attitude toward the appearance of painting. In order to pursue art creation, people must be able to see, understand rationally, and feel emotions (108). Only with these three functionalities can the knowledge be coordinated with the skill of operation to burgeon into a picturesque artwork (2). In these cunning worlds, where technology has mercilessly transformed the milieu invisibly, are the foundering principles acting behind the veil of the art discipline (109). Like any other activity as a human craft, knowledge is the first essential into mastering (110, 111).

At the touch of a button, technology has brought us unparagoned curtness - but the skill of how to carry out has still yet to be initiated. In recent decades, AI has propagated a raft of myriad devices that fulfill our daily lives (112). With the updated method, designers always have benefitted considerably. When beginning the initial design of a new project, designers always exhibit a multitude of art sketches (113). As time goes on, one will overview, delete, replace, or embody any new idea. Nonetheless, it's a regretful nod to recognize that the designing profession is inaccessible for every Tom, Dick, and Harry. Now is the time to delimit the design thinking processes, which mostly agent the drawing related types. Over to AI, human creativity was ignored by severed claims that only the certain chess games could be playable. With illustrations of the discussion about the painting dialect, these tacit understandings are tackled in a merely mechanistic, unthoughtful way (114).

8.1. Ethical Considerations

Recently, an increased interest in the improvement and application of artificial intelligence (AI) technology has led to a change from applying rule-based systems to neural-network-based learning models. These advanced AI models can give the impression that they possess human abilities such as imagination, reasoning, creativity, and emotions (14). Although these AI systems use vast amounts of data, it is controversial whether these models can truly mimic human brain processing. With that in mind, these AI models tend to pose as a counseling agent by offering responses to the user's queries. Since these AI models are anonymic systems, they simply provide information based on the input content. Accordingly, there should be a sense of restraint when assuming that these AI systems understand all messages and contexts. It is advised to be cautious about how the arbitrary prompts are processed, and the weight placed on specific keywords. Given this historical background, it is vital to investigate the developed prompts generated through models like GPT-2. The focus should be on how to modify the prompts and investigate whether they balance and de-bias the weight of specific phrases. According to these findings, the BiasEqualizer, which can be applied to any input text before being used as a prompt, changes the sentences generated by GPT-

2. This is important, as studies suggest that prompted conversations can be more personal than unprompted exchanges due to the user's emotional burden. Since they are written by users, generated or creative activities can also better release feelings than verbal expressions. Understanding human intention is critical to leveraging these models for productivity and well-being in creative or therapeutic activities (115). It is vital to see if there is a valid way to evade a specific AI response to a given query before studying the methods of developing prompt-neutralizing code. Subsequently, it is worthwhile exploring if generated music, text, drawing, or spoken poetry helps users regulate and express their emotions, including those from diverse backgrounds. Nevertheless, it is essential to recognize that they represent just a map and a date, as the proposed framework is still in its early stages, and new models are increasingly becoming available (116).

8.2. Technical Limitations

Taking snapshots during this AI-aided personal painting task serves as an invaluable opportunity to explore the potential of human activities for collaboration-based, snapshots-guided drawing education with an AI. However, researchers encounter technical limitations (117). Generally, non-technically equipped elderly may only be guided through a drawing task, resembling a game of telephone, with a child's stance. The drawing education framework suggested does not prevent both parties from providing additional information and directions. For a generation of senior-friendly AI art influencers for collaboration-based drawing education, the AI painting model's ability must go beyond mere personal content generation but be extended collaboratively over crossed discussions. Behind-the-scenes driven conversation data should ideally be meaningful while minimizing the access to manually remote human painters. For practical learning, seniors' questions are framed constructively for young artists. Converting AI-painter history data into two forms of a simplified question form of textual queries and a complex first stroke made up of a coordinate data list may enable similarly meaningful conversation snapshots (118). Towards expanded data-driven AI research possibilities, extensive complementary uses of this unique data infrastructure may serve the human-AI art skills enhancement framework well.

9. Future Directions

Art, Visual Representation, and the Consumer's State of Knowledge. The effort to decode the content of visual images is currently a very active and productive field within the arts and humanities. Socially, images, like every other sign, are subject to an infinite interpretability, and trying to fix the meaning itself of a single visual document would be a kind of violence against the drift of the thing in the fluid of signs. However, images can indeed be read: if the hermeneutic potential of every image as a sign is mega-reducible, and ends up disappearing into a thriller-like why-and-how, basic visual cues, together with an admittedly large number of different types of

independent information, can be taken as leading edges towards an understanding of the kind of fact it is intended to visually convey. This, as a matter of fact, happens every day in professional and judicial practices concerning the decoding of forensic images, and the kind of approach to the image that has resulted up to now has quite a lot of attendant scientific literature. Clearly, this approach does not get rid of the intrinsic ambiguity of the image as a sign, but at least it is a move towards an assessment of when and how a certain intended meaning of the visual work could have become "ostensible" (86). From a semiotic point of view, breaking the code of a 15th century coat of arms might be insolvable, but a look at the document will at least show that representing two warriors in the act of fighting seems to match a deceit treaty of peace: that is, there is a general agreement in the codes. Similarly, a series of pictures representing a gangland-style killing and its back-stage could be said to refer to "things"—terrible things, but such a simple thing, anyway—that match what everybody knows about assassinations and criminal tradition, as far as these things remain equally terrible. Types of visual documents (119). Visual representations are found in several domains: they may be produced on purpose as direct representations of facts or may be something of a by-product of a fact. In the scientific and juridical field dealing with images, images are categorized as being direct representations of fact when both the chain of creation and the content (and eventually the appearance) of the document are known apt to the context (120).

9.1. Integrating AI in Curricula

Modern education recognizes the increasing role of artificial intelligence in enhancing human cognition, artistic creativity, and other cognitive domains. It is important to incorporate this understanding into curricula planning. Thus, a conceptual framework is proposed for the 'Neural Palette' to expand the foundation of student creativity development by integrating AI learnware (121). The case of AI-assisted painting offers a tangible example of using this conceptual framework in college arts and design programs, making curriculum recommendations and exploring the future of AI learnware in art education. This is especially timely in that the global trend is increasingly driven by artificial intelligence industries (122, 123).

The 21st-century landscape will likely be dominated by the Internet-of-Things and ever-smarter, AI-powered robotic technology in various productive and reproductive applications. This industrial trend is expected to create a loss of many traditional jobs, including those in painting, drawing, and other creative vocations. If creativity is conceived as a critical job skill and inborn talent, there would not be much need to worry. Yet, increasingly more acknowledgment is given to the idea that creativity can actually be trained and cultivated; and therefore, many skills traditionally categorized as uniquely and fundamentally human—such as joint physical and emotional/ethical engagements, coherent dialogical expression and interpretation, aesthetic commitment, and extraordinary flexible and imaginative manipulations—may likely be surpassed

by future super-smart AI systems, driven by astonishing resources available and the lack of interference from traditional physical/biological hardware constraints.

The debut of brush and color is considered as a spring day for potential great painters. This metaphor of traditional Chinese literati culture underscores the importance of using the right tools and following the right methods in cultivating artistic talent (124). Indeed, good paintings result not only from a gifted inborn talent, but also from a long-history and cutting-edge technical master shrouded in an innovative step-by-step pedagogical lineage passed on intergenerationally (Chen et al., 2022). Byron Katie insists that only the mind reined by the right question(s) can bring the precipitation of happiness (125). Mind and thought, like brush and paper, are only effective under the guidance of the right method and the right non-dual object.

9.2. Research Opportunities

The neural palette: cognitive development, artistic creativity, and the future of AI-assisted painting education. A convergence of science is producing new insights across a wide range of questions in the nexus of technology, cognitive development, and the arts. Concentrated waves of neurocognitive data are helping to map the intricate dynamics of both how we see art and how we create it, with implications for questions of style and aesthetic appreciation as well as broader discourse on imaginative thinking and predictive processing. (126)

The first section of this review considers a growing understanding of how human perception and production of art-shaped products develops across the primate order and into the human-specified domains of drawing, painting, and pictures. It is noted that Picasso's sudden development of an adult sense of proportion that pre-empted his early masterpieces is remarkable but not mystical in the light of modern developmental evidence (127). A second section considers the surprisingly fluid concept of creativity, tracking recent debates about what constitutes a “work of art” through an unexpected stopover at the British Tax Authorities (128). The journey goes on to consider the aesthetics of extreme art forgery, children's art, and neural-net generated noodle bar PR stunts

Along with the surprises, there is also a sense that new industrial applications of automated art are inevitable and deserve serious attention (129). This thought leads to a consideration of art education and how, in an age when algorithms can win music awards and write entire novels, there might be ethical, legal, and philosophical complications regarding school dividing lines between original and computer-aided works (130). Understanding the neural palettes behind Picasso's first words, why your eye sometimes sees ghosts, and the future of rendering instruction raises a series of unanswered questions ripe for future neurocognitive exploration.

10. Case Studies

In this research, we first described a prototype of an intelligent digital canvas, which is able to learn from a user's real-time mid-air pointing behavior. Following this, the development of a

reinforcement learning agent is detailed that adapts the canvas to its painter in such a way that the painter is supported in its drawing process (131). To discover how best the AI could interact with the users in learning and inking, an empirical user study on drawing experiences was conducted with participants. The study compared the behavior of a vanilla baseline agent that partners with the painter in generating inkings, and a more sophisticated agent that further learned and adapted to the painter's actions.

In a focus group study with professional, industrial users of digital art media, drawing practices and artistic values related to essential brush properties - expressive marks, variation in shape and color - have been explored. Drawing with conventional brushes on paper is well understood in the arts, both conceptually and in terms of effective techniques (132). Comparison with digital tools, as used for digital drawing and painting, indicates that the paper and brush axes have not been fully carried over to digital media. There are a variety of analytics services for parsing natural language texts, and uses similar approaches for understanding drawings. However, reflecting networks of actions, influences, intentions, and interpretations, and drawings are multi-modal, integrating schematic representations with annotations, graphs, cartoons, sketches, or written notes in diverse script systems.

10.1. Successful Implementations

Drawing is the most basic foundation in the visual arts. Drawing on the creative images in the brain to form visible characters with the help of tools can show visual creativity and imaginative skills. The combination of shadows and colors can enhance the charm of the artwork. In the traditional way, drawing is a technique that needs to be learned. Designers often use a lot of sketches when generating design ideas. The teaching of drawing cannot solve all the problems. If you want to get a satisfactory sketch, you often need more practice and mastery of the skill of the pen. Practice often requires a lot of time and it is also affected by technical habits. The nature of human beings cannot be separated from life, life cannot be separated from culture, and culture cannot be separated from art. The combination of technology and art has become an inevitable trend. Currently developed artificial intelligence can change the traditional workflow of creating art pieces by enabling new innovative painting tools, turning paintings into stories, or offering new ways for interacting in an immersive environment. The technical possibilities and the potential of developing painting software applications driven by artificial intelligence that goes beyond the simple simulation of traditional painting tools are explored. The drawing has been shown to be a form of creativity that is beyond modelling. Drawing forces to give representation to a mental model rather than merely to act on it, helping children develop a better understanding of concepts (41). Recently developed solutions in the field of AL code generation for digital creative tasks such as drawing, music production and 3D modelling based on the collected data on the intelligence level and expertise level of the artist and the development trends in their creativity. Several research

problems and challenges were identified. Machines capable of creating artwork just like human painters have improved and their results are bolder and more realistic (133). Furthermore, the widespread use of multiple filters in various applications can generate interesting unusual works. The contemporary machine-generated art is as legitimate as the classical, created by the human hand, with which the viewer can have profound emotional experiences, connected with the cognition of the artwork's aesthetic values and the history of the work's genesis (134).

10.2. Comparative Analyses

Artistic achievement is a combination of culture and technology. Originating from the simultaneous development of humans, the works of painting and artistic expression are vast, rich, and diverse. Thus, to be able to fully employ thoughts and expressions, one must be able to see them, understand them rationally, and sense emotions so that the cognitive method is fully believe. The mode of living and cognitive development results from the technology, which always changes fast. This change in technology has made civilization more and more complex, while the way of living and thinking of mankind is no longer simple. Nowadays, the modifiable, adjustable, and changeable characteristics of machinery have made the need for an understanding of technical aesthetics and art activities grow rapidly. For this reason, the development of technology has changed the traditional approach to materials and methods in the art forms of design. Moreover, it is observed that in the art form of painting, the use of freehand brushwork lines can fill more color than technical pen drawing (135). This freehand brushwork line can therefore be noted to show spacial depth and record the emotion performance in the stroke. Due to the different delineation characteristics and digital processing methods, there is a substantial difference in the visual effects presented on paper between technical pen drawing and freehand brushwork. It is argued that rough sketch is the simplest art tool in art creation activities and is the fastest and most direct means for idea transmission. It is always employed in the early stage of design to extract design inspiration and convey concept information (136). Furthermore, it provides a space of freedom and no constraints on ideas, and designers or painters can sketch freely and naturally.

11. Conclusion

Every summer, families across the country embark on the collective quest for the perfect, quintessentially artistic activity: the paint-and-sip. Imbibing wine or cocktails, celebrants cajole acrylic pigments onto wood or canvas plates for two-hour bouts. Paint-and-sips have lately discerned a new kind of competition however. Such tools as the Deep Dream Algorithm or convolutional neural networks have garnered acclaim for their evident capacity to generate art (137).

Recently, convolutional neural networks have been proposed as a means of guiding design choices about marble sculptures or academic posters. These tools are perceived as eerie or suspect by a

playful or queer theorist, who questions their anticipated ability to evaluate conceptual works. In an alternate approach, which does not so much leverage convolutional neural networks as adopt their infrastructures, Visco sets out to demonstrate the strange, almost comically contrasting results that can be obtained when commissions are instead executed by convolutional networks trained on images dating from the last fifty years (138).

References:

1. Evans O. Sensory Optimization: Neural Networks as a Model for Understanding and Creating Art. 2019.
2. Wu Y, Wang X, Zhao W, Lv X. A novel topic clustering algorithm based on graph neural network for question topic diversity. Information Sciences. 2023.
3. Gu H. Data, big tech, and the new concept of sovereignty. Journal of Chinese political science. 2024.
4. Liu J, Zhang L, Yan Q. I-Topic: An Image-text Topic Modeling Method Based on Community Detection. 2024 5th International Conference on Computer Engineering and Application (ICCEA); 2024/4: IEEE; 2024. p. 797-800.
5. Govea J, Ocampo Edye E, Revelo-Tapia S, Villegas-Ch W. Optimization and scalability of educational platforms: Integration of artificial intelligence and cloud computing. Computers. 2023;12(11):223.
6. Demartini CG, Sciascia L, Bosso A, Manuri F. Artificial intelligence bringing improvements to adaptive learning in education: A case study. Sustainability. 2024.
7. Dutta S, Ranjan S, Mishra S, Sharma V, Hewage P, Iwendi C. Enhancing educational adaptability: A review and analysis of AI-driven adaptive learning platforms. 2024 4th International Conference on Innovative Practices in Technology and Management (ICIPTM); 2024/2: IEEE; 2024. p. 1-5.
8. Min J, Park YK. Order Effect of Warm-Cool Judgment of Colors. Archives of Design Research. 2024.
9. Koenderink JJ, van Doorn AJ, Braun DI. “Warm,”“cool,” and the colors. Journal of Vision. 2024.
10. Zheng L, Xu L. Comparing AI and Human Emotional Responses to Color: A Semantic Differential and Word-Color Association Approach. Color Research & Application. 2025.
11. Candry P, De Visschere P, Neyts K. Line element for the perceptual color space. Optics Express. 2022.
12. Hjort MM. Neural Dynamics of Cognitive Flexibility: Meta-RPE Signaling Within a Prelimbic Cortex-Ventral Tegmental Area Circuit Expedites Contingency Degradation During. 2024.

13. Khan R, Ma X, Taj S, Hassan H, Ullah I, Alwabli A, et al. Bridging the Future: The Confluence of Internet of Things and Artificial Intelligence in Communication System. Future Communication Systems Using Artificial Intelligence, Internet of Things and Data Science: CRC Press; 2023. p. 30-54.
14. Kyung Lee Y, Park YH, Hahn S. A Portrait of Emotion: Empowering Self-Expression through AI-Generated Art. 2023.
15. Xu L, Xu H, Luo J, Zhang R, Pan Y, Xu J. Immersive Digital Art Experience: An Empirical Study on Audiences' Switching Intention to Metaverse Online Art Museum. IEEE Access. 2025.
16. Zhang YL. Three Essays on Technological Innovations and Human Decisions. 2022.
17. Vidal PP, Lacquaniti F. Perceptual-motor styles. Experimental Brain Research. 2021.
18. Vickhoff B. Why art? The role of arts in arts and health. Frontiers in Psychology. 2023.
19. Richard V, Holder D, Cairney J. Creativity in motion: Examining the creative potential system and enriched movement activities as a way to ignite it. Frontiers in Psychology. 2021.
20. Fan X, Zhong X. Artificial intelligence-based creative thinking skill analysis model using human–computer interaction in art design teaching. Computers and Electrical Engineering. 2022.
21. Khalil R, Demarin V. Creative therapy in health and disease: Inner vision. CNS Neuroscience & Therapeutics. 2024.
22. Spee B, Stap TB, Plijnaer M, Pasman G, Zeggio S, Duits A, et al. Co-creating a person-centered creative engagement intervention for Parkinson's care. Frontiers in Psychology. 2025;15:1469120.
23. Wiggins GA, Bhattacharya J. Mind the gap: an attempt to bridge computational and neuroscientific approaches to study creativity. 2014.
24. Lebuda I, Benedek M. A systematic framework of creative metacognition. Physics of Life Reviews. 2023.
25. Oksanen A, Cvetkovic A, Akin N, Latikka R, Bergdahl J, Chen Y, et al. Artificial intelligence in fine arts: A systematic review of empirical research. Computers in Human Behavior: Artificial Humans. 2023;1(2):100004.
26. Järvelä S, Nguyen A, Hadwin A. Human and artificial intelligence collaboration for socially shared regulation in learning. British Journal of Educational Technology. 2023;54(5):1057-76.
27. Verganti R, Dell'Era C, Swan KS. Design thinking: Critical analysis and future evolution. Journal of Product Innovation Management. 2021;38(6):603-22.
28. Alsharif AH, Salleh NZM, Baharun R. The neural correlates of emotion in decision-making. International Journal of Academic Research in Business and Social Sciences. 2021;11(7):64-77.
29. Chatterjee A. Art in an age of artificial intelligence. Frontiers in Psychology. 2022.

30. Wu Y. Critical Thinking Pedagogics Design in an Era of ChatGPT and Other AI Tools—Shifting From Teaching "What" to Teaching "Why" and "How". Journal of Education and Development. 2024.
31. Acs ZJ, Song AK, Szerb L, Audretsch DB, Komlósi É. The evolution of the global digital platform economy: 1971–2021. Small Business Economics. 2021;57:1629-59.
32. Villalobos P, Sevilla J, Heim L, Besiroglu T, Hobbhahn M, Ho A. Will we run out of data? an analysis of the limits of scaling datasets in machine learning. arXiv preprint arXiv:2211 04325. 2022.
33. Lai X, Huang Y, Deng C, Gu H, Han X, Zheng Y, et al. Sorting, regrouping, and echelon utilization of the large-scale retired lithium batteries: A critical review. Renewable and Sustainable Energy Reviews. 2021;146:111162.
34. Audry S. Art in the age of machine learning. 2021.
35. Kuker H. The Consciousness of Art: Advocating for a Free Culture Approach to AI Regulation in a Self-Regulated Art Industry. 2025.
36. Azagra Caro J. Visibility without protection? Barriers to women researchers' engagement in artistic practices and science communication through art. 2025.
37. Schwalbe-Koda D, Tan AR, Gómez-Bombarelli R. Differentiable sampling of molecular geometries with uncertainty-based adversarial attacks. Nature communications. 2021;12(1):5104.
38. Goriely A. Eighty-six billion and counting: do we know the number of neurons in the human brain? Brain. 2025.
39. Lent R. Yes, the human brain has around 86 billion neurons. Brain. 2025.
40. Dorkenwald S, Matsliah A, Sterling AR, Schlegel P, Yu SC, McKellar CE, et al. Neuronal wiring diagram of an adult brain. Nature. 2024;634(8032):124-38.
41. Geiger F, Martin M, Pichlmair M, Aslan I, Ritschel H, Bittner B, et al. Drawing with AI - Exploring Collaborative Inking Experiences Based on Mid-air Pointing and Reinforcement Learning. 2020.
42. Bowers JS, Malhotra G, Dujmović M, Montero ML, Tsvetkov C, Biscione V, et al. Deep problems with neural network models of human vision. Behavioral and Brain Sciences. 2023;46:e385.
43. Nourani M, Roy C, Block JE, Honeycutt DR, Rahman T, Ragan ED, et al. On the importance of user backgrounds and impressions: Lessons learned from interactive AI applications. ACM Transactions on Interactive Intelligent Systems. 2022;12(4):1-29.
44. Wichmann FA, Geirhos R. Are deep neural networks adequate behavioral models of human visual perception? Annual Review of Vision Science. 2023.
45. Nurmi M. Temporal constraints and creativity in bass lines of eminent jazz musicians [Ph.D. Thesis]: JYU Dissertations; 2023.

46. Ullah U, Choi HC. MuIm: Analyzing Music–Image Correlations from an Artistic Perspective. Applied Sciences. 2024.
47. Chung J. Steerable AI-powered Art-making Tools. 2023.
48. Hutson J, Lively J, Robertson B, Cotroneo P, Lang M. Painting by numbers: A brief history of art and technology. Creative Convergence: The AI Renaissance in Art and Design: Springer Nature Switzerland; 2023. p. 37-85.
49. Garcia MB. The paradox of artificial creativity: Challenges and opportunities of generative AI artistry. Creativity Research Journal. 2024.
50. Bardini R. From sketch to landscape: Transforming neuronal concepts across technological change. Systems Biology and In-Depth Applications for Unlocking Diseases: Academic Press; 2025. p. 37-52.
51. Jora OD, Iacob M, Rosca VI, Nedelcu MR, Preda AF, Nedef MS. Artificial intelligence and artistic imagination: Revisiting the cultural economy of industrial revolutions. Amfiteatru Economic. 2024;26(66):613-32.
52. Wojnowski K. The dawn of the dead : (improbable) art after aI-zombie apocalypse. 2018.
53. Hertzmann A. Generative Models for the Psychology of Art and Aesthetics. Empirical Studies of the Arts. 2025.
54. Chavlis S, Poirazi P. Drawing inspiration from biological dendrites to empower artificial neural networks. Current Opinion in Neurobiology. 2021.
55. Shao F, Shen Z. How can artificial neural networks approximate the brain? Frontiers in Psychology. 2023.
56. Lee U, Jeon M, Lee Y, Byun G, Son Y, Shin J, et al. LLaVA-Docent: Instruction Tuning with Multimodal Large Language Model to Support Art Appreciation Education. 2024.
57. Tan J, Kannis-Dymand L, Jones C. Examining the potential of VR program Tilt Brush in reducing anxiety. Virtual Reality. 2023.
58. Haeyen S, Jans N, Heijman J. The use of VR tilt brush in art and psychomotor therapy: An innovative perspective. The Arts in Psychotherapy. 2021.
59. Riches S, Bartlett U, Bird Z, Williams G, Nicholson SL, Winter H, et al. Implementing a virtual reality-based intervention to support the wellbeing of mental health staff in the workplace: A mixed-methods pilot study. Journal of Workplace Behavioral Health. 2024:1-15.
60. Shen Z, Piao Y, Tan C, Lin R, Zhao X, Wan X. Project Co-Art: Improving Children's Imagination Through AI-based Human-Computer Co-creation. 2022 IEEE Smartworld, Ubiquitous Intelligence & Computing, Scalable Computing & Communications, Digital Twin, Privacy Computing, Metaverse, Autonomous & Trusted Vehicles (SmartWorld/UIC/ScalCom/DigitalTwin/PriComp/Meta); 2022/12: IEEE; 2022. p. 1597-602.

61. Ozbay Y, Oosterwijk S, Stamkou E. Beyond beauty: Does visual art facilitate social cognitive skills? Plos One. 2024.
62. van Leeuwen JE, Boomgaard J, Bzdok D, Crutch SJ, Warren JD. More than meets the eye: Art engages the social brain. Frontiers in Neuroscience. 2022;16:738865.
63. Kastner L, Umbach N, Jusyte A, Cervera-Torres S, Fernández SR, Nommensen S, et al. Designing visual-arts education programs for transfer effects: development and experimental evaluation of (digital) drawing courses in the art museum designed to promote adolescents' socio-emotional skills. Frontiers in Psychology. 2021;11:603984.
64. James CE, Tingaud M, Laera G, Guedj C, Zuber S, Diambrini Palazzi R, et al. Cognitive enrichment through art: a randomized controlled trial on the effect of music or visual arts group practice on cognitive and brain development of young children. BMC Complementary Medicine and Therapies. 2024;24(1):141.
65. Yu J, Rawtaer I, Goh LG, Kumar AP, Feng L, Kua EH, et al. The art of remediating age-related cognitive decline: Art therapy enhances cognition and increases cortical thickness in mild cognitive impairment. Journal of the International Neuropsychological Society. 2021;27(1):79-88.
66. Meng X, Zhang M, Wang M. Effects of school indoor visual environment on children's health outcomes: A systematic review. Health & Place. 2023.
67. Tyler Rosier J. Art and Memory: An Examination of the Learning Benefits of Visual-Art Exposure. 2010.
68. Fekete A, Maidhof RM, Specker E, Nater UM, Leder H. Does art reduce pain and stress? A registered report protocol of investigating autonomic and endocrine markers of music, visual art, and multimodal aesthetic. PloS One. 2022.
69. Candia V, Kusserow M, Margulies O, Hildebrandt H. Repeated stage exposure reduces music performance anxiety. Frontiers in Psychology. 2023;14:1146405.
70. Chen SY, Lin PH, Chien WC. Children's digital art ability training system based on AI-assisted learning: A case study of drawing color perception. Frontiers in Psychology. 2022.
71. Bjorklund DF. Children's thinking: Cognitive development and individual differences. 2022.
72. Mursid R, Saragih AH, Hartono R. The Effect of the Blended Project-Based Learning Model and Creative Thinking Ability on Engineering Students' Learning Outcomes. International Journal of Education in Mathematics, Science and Technology. 2022;10(1):218-35.
73. Thornhill-Miller B, Camarda A, Mercier M, Burkhardt JM, Morisseau T, Bourgeois-Bougrine S, et al. Creativity, critical thinking, communication, and collaboration: assessment, certification, and promotion of 21st century skills for the future of work and education. Journal of Intelligence. 2023;11(3):54.
74. Sawyer RK, Henriksen D. Explaining creativity: The science of human innovation. 2024.

75. Alam A, Mohanty A. Does Musically Responsive School Curriculum enhance Reasoning Abilities and Helps in Cognitive Development of School Students? Interdisciplinary Perspectives on Sustainable Development: CRC Press; 2023. p. 337-41.
76. Sasson Lazovsky G, Raz T, Kenett YN. The art of creative inquiry—from question asking to prompt engineering. The Journal of Creative Behavior. 2025;59(1):e671.
77. Lael Siler T. Neuro-impressions: interpreting the nature of human creativity. 2012.
78. Cetinic E, She J. Understanding and creating art with AI: Review and outlook. ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM). 2022;18(2):1-22.
79. Watkins C, Scott L. From the stage to the studio: How fine musicians become great teachers. 2023.
80. Koh Y, Galligan A. The Fractured Professionalization in Arts Education. Professionalization in the Creative Sector. 2023.
81. Seekoe L. Investigating Teacher Artist Partnership Programmes as Possible Intervention for the Professional Development of Creative Arts Educators at Public Schools in. 2022.
82. Allan D. Celebrating Our Volunteer Leaders: A Heartfelt Thank You. Journal of Singing. 2024.
83. Kumari P, Goswami V, N H, Pundir RS. Recurrent neural network architecture for forecasting banana prices in Gujarat, India. Plos One. 2023.
84. Yemini E, Lin A, Nejatbakhsh A, Varol E, Sun R, Mena GE, et al. NeuroPAL: a multicolor atlas for whole-brain neuronal identification in C. elegans. Cell. 2021;184(1):272-88.
85. Ribes J, Pareja L, Sanz X, Mosteiro S, Escribà JM, Esteban L, et al. Cancer diagnosis in Catalonia (Spain) after two years of COVID-19 pandemic: an incomplete recovery. ESMO Open. 2022;7(3):100486.
86. Crimaldi F, Leonelli M. AI and the creative realm: A short review of current and future applications. 2023.
87. Tims M, Twemlow M, Fong CYM. A state-of-the-art overview of job-crafting research: current trends and future research directions. Career Development International. 2022.
88. De Witte M, Orkibi H, Zarate R, Karkou V, Sajnani N, Malhotra B, et al. From therapeutic factors to mechanisms of change in the creative arts therapies: A scoping review. Frontiers in Psychology. 2021;12:678397.
89. Prokopovych T, Tarasiuk I, Zinko D, Panfilova O, Berlach O, Vilgushynskyi R. FEATURES OF FINE ARTS OF THE EARLY 21ST CENTURY: PAINTING, DRAWING, SCULPTURE. AD ALTA. 2023;13(1).
90. Gilson E. Painting and reality. 2023.

91. Xu P, Hospedales TM, Yin Q, Song YZ, Xiang T, Wang L. Deep learning for free-hand sketch: A survey. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2022;45(1):285-312.
92. Jenkins E. Drawn to Design: Analyzing Architecture Through Freehand Drawing--Expanded and Updated Edition. 2022.
93. Moreira da Silva A. Drawing as a strategy on design education. Perspectives on Design II: Research, Education and Practice2022. p. 105-15.
94. Gürel E. Observational Sketching as Tool for Experiencing Place: A Comparative Study of Free-Hand Sketching and Photography. 2022.
95. Maule J, Skelton AE, Franklin A. The development of color perception and cognition. Annual Review of Psychology. 2023.
96. Nair AS, Priya RS, Rajagopal P, Pradeepa C, Senthil R, Dhanalakshmi S, et al. A case study on the effect of light and colors in the built environment on autistic children's behavior. Frontiers in Psychiatry. 2022;13:1042641.
97. Luo N, Ibrahim R, Abidin SZ. Transformation of children's paintings into public art to improve public spaces and enhance people's happiness. International Journal of Environmental Research and Public Health. 2022;19(24):16780.
98. Creely E, Blannin J. Creative partnerships with generative AI. Possibilities for education and beyond. Thinking Skills and Creativity. 2025.
99. Borger JG, Ng AP, Anderton H, Ashdown GW, Auld M, Blewitt ME, et al. Artificial intelligence takes center stage: exploring the capabilities and implications of ChatGPT and other AI-assisted technologies in scientific research and education. Immunology and Cell Biology. 2023;101(10):923-35.
100. Caldeira WG, Simões JM. Disrupting the Conventional: The Impact of Generative AI Models on Creativity in Visual Communications. E-Revista de Estudos Interculturais. 2024.
101. Cádiz RF, Macaya A, Cartagena M, Parra D. Creativity in generative musical networks: evidence from two case studies. Frontiers in Robotics and AI. 2021;8:680586.
102. Epstein Z, Hertzmann A, Herman L, Mahari R, Frank MR, Groh M, et al. Art and the science of generative AI: A deeper dive. 2023.
103. Rani P, Kotwal S, Manhas J, Sharma V, Sharma S. Machine learning and deep learning based computational approaches in automatic microorganisms image recognition: methodologies, challenges, and developments. Archives of Computational Methods in Engineering. 2022;29(3):1801-37.
104. Nandhini Abirami R, Durai Raj Vincent PM, Srinivasan K, Tariq U, Chang CY. Deep CNN and deep GAN in computational visual perception-driven image analysis. Complexity. 2021;2021:5541134.

105. Gong Y. Application of virtual reality teaching method and artificial intelligence technology in digital media art creation. Ecological Informatics. 2021.
106. Oppenlaender J, Linder R, Silvennoinen J. Prompting AI art: An investigation into the creative skill of prompt engineering. International Journal of Human–Computer Interaction. 2024:1-23.
107. Onyejelem TE, Aondover EM. Digital generative multimedia tool theory (DGMTT): a theoretical postulation. Journalism. 2024.
108. Chen SY, Lin PH, Chien WC. Children's Digital Art Ability Training System Based on AI-Assisted Learning: A Case Study of Drawing Color Perception. 2022.
109. Rasmussen LL. The Planet You Inherit: Letters to My Grandchildren when Uncertainty's? a? Sure Thing. 2022.
110. Facer K, Siebers J, Smith B. Working with time in qualitative research: Case studies, theory and practice. 2021.
111. Reckwitz A. The end of illusions: Politics, economy, and culture in late modernity2021 2021.
112. Khan RNM, Majid A, Shim SO, Habibullah S, Almazroi AA, Hussain L. Intelligent Bayesian Inference for Multiclass Lung Infection Diagnosis: Network Analysis of Ranked Gray Level Co-occurrence (GLCM) Features. New Generation Computing. 2024;42(5):997-1048.
113. Suleyman M. The coming wave: technology, power, and the twenty-first century's greatest dilemma. 2023.
114. Loscri V, Symeonidis I, Griesbacher M, Deniau V, Andreoletti D, Chiumento A, et al. Interdisciplinary Security Aspects of Next-Generation Wireless Networks and Systems: BEiNG-WISE: State of Research and Future Research Steps. 2025.
115. Liang W, Tadesse GA, Ho D, Fei-Fei L, Zaharia M, Zhang C, et al. Advances, challenges and opportunities in creating data for trustworthy AI. Nature Machine Intelligence. 2022;4(8):669-77.
116. Spitale G, Biller-Andorno N, Germani F. AI model GPT-3 (dis) informs us better than humans. Science Advances. 2023.
117. Zhang Y, Huang N, Tang F, Huang H, Ma C, Dong W, et al. Inversion-based style transfer with diffusion models. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition; 20232023. p. 10146-56.
118. Gurieva N. Emerging technologies for the educational process: the use of artificial intelligence in digital art projects. 2024.
119. Luccioni S, Akiki C, Mitchell M, Jernite Y. Stable bias: Evaluating societal representations in diffusion models. Advances in Neural Information Processing Systems; 20232023. p. 56338-51.

120. Brennen JS, Simon FM, Nielsen RK. Beyond (mis) representation: Visuals in COVID-19 misinformation. The International Journal of Press/Politics. 2021;26(1):277-99.
121. Yang SJ, Ogata H, Matsui T, Chen NS. Human-centered artificial intelligence in education: Seeing the invisible through the visible. Computers and Education: Artificial Intelligence. 2021;2:100008.
122. Siemens G, Marmolejo-Ramos F, Gabriel F, Medeiros K, Marrone R, Joksimovic S, et al. Human and artificial cognition. Computers and Education: Artificial Intelligence. 2022;3:100107.
123. Seaba VES. Revolutionizing Education: Exploring the Potential of AI-Enabled Brain-Based Learning for Enhanced Cognitive Development. Open Access Library Journal. 2023.
124. Kelin LI. Season and History: Guo Xi's Expression of Time in His Painting Practice. Yearbook for Eastern and Western Philosophy. 2024.
125. Brooks K. The New Oil Painting: Your Essential Guide to Materials and Safe Practices. 2021.
126. van Bree S. Uncovering neural patterns of cognition by aligning oscillatory dynamics. 2024.
127. Białkowski Ł. Artificial intelligence and concerns about 'true'art. Remarks on why human art is overrated and AI-made art unjustifiably undervalued. Art Inquiry. 2024.
128. Białkowski Ł. ARTIFICIAL INTELLIGENCE AND CONCERNS ABOUT'TRUE'ART. Art Inquiry. 2024.
129. Carpo M. Beyond digital: design and automation at the end of modernity. 2023.
130. Howcroft D, Taylor P. Automation and the future of work: A social shaping of technology approach. New Technology.
131. Dunwoodie K, Macaulay L, Newman A. Qualitative interviewing in the field of work and organisational psychology: Benefits, challenges and guidelines for researchers and reviewers. Applied Psychology. 2023.
132. Forbes C. Drawing With The Brush: Eastern Inspiration for the Western Artist. 2023.
133. Arnheim R. Visual thinking. 2023.
134. Sheridan KM, Veenema S, Winner E, Hetland L. Studio thinking 3: The real benefits of visual arts education. 2022.
135. Yılmaz A. Effect of technology integration in education on prospective teachers' critical and creative thinking, multidimensional 21st century skills and academic achievements. Participatory Educational Research. 2021.
136. Gerlitz L, Prause GK. Cultural and creative industries as innovation and sustainable transition brokers in the Baltic Sea region: A strong tribute to sustainable macro-regional. Sustainability. 2021.

137. Alkhazraji L, Abbas AR, Jamil AS, Kadhim ZS, Alkhazraji W, Jebur SA, et al. Employing the Concept of Stacking Ensemble Learning to Generate Deep Dream Images Using Multiple CNN Variants. Intelligent Systems with Applications. 2025:200488.
138. Mishra V, Kane L. A survey of designing convolutional neural network using evolutionary algorithms. Artificial Intelligence Review. 2023.