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Educação Matemática Debate

Creativity in Mathematics classes: insurrection via art and AI

Abstract: The study, in the form of a theoretical essay, discusses the exercise of creativity in math classes through art, giving rise to creativity as a creative power and as a way of being in the world. To make the discussions more tangible, images generated by Artificial Intelligence (AI) are used and an activity is proposed, inspired by the paintings of Russian artist Georgy Kurasov, which addresses mathematical elements and enhances creative thinking. The proposal defends art as an insurrection against the pimping/banality of life, inviting students to an aesthetic exercise in math class, to express themselves creatively in the world and to break away from the fast pace of productivity.

Keywords: Creativity. Mathematics and Art. Gregory Kurasov. Artificial Intelligence.

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Article

Creatividad en las clases de Matemáticas: insurrección a través del arte y la IA

Resumen: El estudio, en forma de ensayo teórico, aborda el ejercicio de la creatividad en las clases de Matemáticas a través del arte, dando lugar a la creatividad como poder creador y como forma de estar en el mundo. Para hacer más tangibles las discusiones, se utilizan imágenes generadas por Inteligencia Artificial (IA) y se propone una actividad, inspirada en las pinturas del artista ruso Georgy Kurasov, que aborda elementos matemáticos y potencia el pensamiento creativo. La propuesta defiende el arte como insurrección contra la alcahuetería/banalidad de la vida, invitando a los alumnos a un ejercicio estético en clase de Matemáticas, a expresarse creativamente en el mundo y a romper con el ritmo acelerado de la productividad.

Palabras clave: Creatividad. Matemáticas y Arte. Georgy Kurasov. Inteligencia Artificial.

Criatividade nas aulas de Matemática: insurreição via arte e Inteligência Artificial

Resumo: O estudo, na forma de um ensaio teórico, discute o exercício da criatividade nas aulas de Matemática por meio da arte, dando vazão à criatividade como potência criadora e como forma de estar no mundo. Para tornar as discussões mais palpáveis, utilizam-se imagens geradas por Inteligência Artificial (IA) e propõe-se uma atividade, inspirada nas pinturas do artista russo Georgy Kurasov, que aborda elementos matemáticos e potencializa o pensamento criativo. A proposta defende a arte como insurreição contra a cafetinagem/banalidade da vida, convidando o estudante a um exercício estético na aula de Matemática, a se expressar criativamente no mundo e a romper com o ritmo acelerado de produtividade.

Palavras-chave: Criatividade. Matemática e Arte. Georgy Kurasov. Inteligência Artificial.

1 Introduction

The term *creativity*, at first glance, seems to be a term that anyone can understand. However, when we read the national documents that define Brazilian education, we realize that, taken in common sense, it is not commented on robustly enough for teachers to understand how they can help students develop their own creativity. Even if it were, defining creativity would not be enough to think about how it could permeate Mathematics classes, since different people express and develop their creativity in different ways.

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Creativity gives rise to behaviors that can be enhanced in the school environment, particularly in Mathematics classes; however, it is necessary to build a space that is favorable to it. In this environment, the teacher, also recognizing himself and acting as a creative being, invites his students to express themselves creatively.

Therefore, the main objective of this study is to discuss the exercise of creativity in Mathematics classes through art, not in relation to a closed concept, but giving vent to creativity as a creative power and as a way of being in the world. To achieve this goal, this text presents possibilities for creativity to enter Mathematics classes based on a dialogue between Mathematics and the paintings of Russian painter Georgy Kurasov, which we do by suggesting a sequence of activities. Thus, we announce, as specific objectives of this study, to encourage some discussions about the potential of art in the educational space and to reflect on the possibilities of using Artificial Intelligence (AI) as a tool for carrying out activities in Mathematics classes.

We chose art as the central theme of this text because we recognize in it its potential for insurrection; in other words, to combat the neoliberal practices and ideologies that are undermining not only the school, but also the joy of being in the world. Furthermore, we understand that art can foster the joint germination of the empirical-logical-rational dimensions, typical of exact disciplines, and the mythical-symbolic-magical dimensions, characteristic of humanities disciplines (Almeida, 2006).

We present this text as a *theoretical essay*, since it has "characteristics of a scientific text, such as a dissertative nature, with theoretical discussion, with the purpose of defending, rationally and logically, a point of view or an idea, without any proposal for further study or pretense of exhausting the subject" (Soares, Picolli and Casagrande, 2018, p. 331). Also as an essay, the article takes the form of a

> critical text, which takes a position. It does not intend to deconstruct what exists, nor to say that one form is better than another in the prevailing scientific production, it only aims to make other possibilities, new paths clear. To discover new possibilities, it is necessary to go beyond what is seen. A leap into the doubtful, into the unknown and into the unusual and accepted by the system (Boava, Macedo and Sette, 2020, p. 70).

Since the core of a theoretical essay is "the permanent reaction between subject and object, a becoming constituted by the interaction of subjectivity with the objectivity of those involved" (Meneghetti, 2011, p. 321), we need, as authors, to point out that the writing of this text is intimately connected to our affection for art — art is part of our lives, our tastes, what we consume and read, hence the natural consequence of it always being on the lookout for a new opportunity to enter our classes.

In this sense, we deny the need to establish a starting point, a zero mark, which would be the embryo of the activity proposed in this article. Although it was not applied to a specific class of students, it echoes previous essays, studies and research already carried out, such as the production of a tea set inspired by the Mayan calendar (Peraça and Montoito, 2015), a study that values the aesthetic and beautiful character of Mathematics based on activities with works by Volpi and Da Vinci (Cardoso, Paulo and Dalcin, 2014) and the development of activities involving the production of photographs (Carvalho and Dalcin, 2023) and analysis of photographic images (Brito and Dalcin, 2022), among others.

This essay is organized as follows: the first sections present theoretical discussions on creativity and art as a creative drive. They are followed by the suggestion of an activity designed

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to explore, develop and promote students' creativity and, if we point out the use of AI for its execution, it is because, from the outset, we recognize that the teacher cannot remain oblivious to new technologies, needing to be creative and also adapt to the new, in addition to learning to extract the best from them — pedagogically speaking.

2 In search of creativity

You have to create confusion systematically, this frees creativity. Everything that is contradictory creates life (Salvador Dalí).

The epigraph of this section is attributed to Salvador Dalí (Nasiotis, 2019), a surrealist painter of Catalan origin, whose paintings have the power to surprise those who see them to this day, given their "artistic expression so free from the control of reason that it escaped the notions of beauty and truth" (Del Puppo, 2011, p. 36). His painting *The Crucifixion*, from 1954, which can be seen at the Metropolitan Museum of Art in New York, provokes mathematical gazes due to the representation of Christ tied to a cross that has the shape of an open hypercube. Dalí's reinterpretation of a biblical scene so well known and widely painted by other renowned painters undoubtedly causes strangeness and confusion, and is an example of the painter's creativity in representing it. Based on this artistic and conceptual preamble, we set out, in this section, in *search of creativity*.

More than a subtitle, this expression characterizes our effort to try to understand what creativity is beyond common sense. In a primary research move, we turned to the dictionary, where we read: "creativity: s.f. creative force; inventiveness; originality" (Borba, 2011, p. 359). However, in recent years, the term has gained new layers of connotations, having been captured by neoliberal discourses and associated with entrepreneurship (De Tommasi, 2014; Pereira et al., 2006; Carmo et al., 2021; Silva, 2024). From this perspective of the postmodern world, creativity seems to be subjugated to the production of something that is recognized by someone, that has a practical use and — if possible, even better — that generates financial profits.

As authors, in this article we wish to escape this utilitarianism and understand creativity in a broader sense, emphasizing its creative power as a way of being in the world, in general, and of being in the Math class, in particular. Therefore, although the ideas surrounding the word have changed over the centuries, we turn our attention to the Greeks, who were the first to coin it.

Barbosa (2023, p. 4) recalls that, given the lack of a word to refer to creative activity, Plato opted for the "verb *poiéō*, which means to create, to make, to produce, to bring into existence, [which] gives rise to the noun *poíēsis*, creation, method of production, which, adapted to Latin, gives rise to the word 'poetry'". It is this meaning that, even though it is not about literary-poetic production, permeates this article. As we will discuss in the following sections, we approach creativity through art as a form of creation that can be, at the same time, a form of existence, resistance and insubordination.

When we want to think about creativity in conjunction with pedagogical practices, we realize that, despite being encouraged, it is not well defined in Brazilian normative documents, its meaning falling back into common sense, so that these documents do not help teachers to approach or deal with the topic. In the old *Parâmetros Curriculares Nacionais* [National Curriculum Parameters — PCN], in the section on Natural Sciences, Mathematics and their Technologies, the word creativity appeared only twice. In one of them, it read:

> In its formative role, Mathematics contributes to the development of thought processes and the acquisition of attitudes, whose usefulness and scope transcend the scope of Mathematics itself, and can form in the student the

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> ability to solve genuine problems, generating habits of investigation, providing confidence and detachment to analyze and face new situations, enabling the formation of a broad and scientific vision of reality, the perception of beauty and harmony, the development of *creativity* and other personal capacities (Brasil, 1997, p. 40, our emphasis).

Today, considering the *Base Nacional Comum Curricular* [National Common Curriculum Base — BNCC], the term creativity gains some prominence in the second[1] general competency of Basic Education and in the learning of Early Childhood Education. In the section *As finalidades do Ensino Médio na contemporaneidade* [The purposes of High School in contemporary times], the term appears associated with the world of work and, once again, with entrepreneurship, when it states that a school that welcomes the youth of this time must be structured to

> provide a culture favorable to the development of attitudes, capabilities and values that promote entrepreneurship (*creativity*, innovation, organization, planning, responsibility, leadership, collaboration, vision of the future, risk-taking, resilience and scientific curiosity, among others), understood as an essential skill for personal development, active citizenship, social inclusion and employability (Brasil, 2017, p. 466, our emphasis).

Subsequently, when defending the use of technologies in education, the aforementioned text points out that the teacher must

> use, propose and/or implement solutions (processes and products) involving different technologies, to identify, analyze, model and solve complex problems in different areas of daily life, effectively exploring logical reasoning, computational thinking, the spirit of investigation and *creativity* (Brasil, 2017, p. 475, our emphasis).

The other references to creativity in the BNCC appear occasionally and only in the areas of Languages and Natural Sciences. This raises several questions: is there no room for creativity in Mathematics classes? Is it not necessary to be creative to study Mathematics? Has nothing creative been produced using mathematical ideas? Can't mathematical rationality be accompanied by creativity? The answer to all these questions is *yes*.

We risk advocating, based on perspectives and practices, for a space in Mathematics classes for creativity. And, although it is possible to present several arguments to bring art and Mathematics closer together, we will focus on a key one for this article: paintings with mathematical elements, as evidenced by the works[2] of Maurits Cornelis Escher, Wassily Kandinsky, Piet Mondrian, Geraldo de Barros and Georgy Kurasov, the latter being the painter whose paintings are the subject of this article.

However, we recognize that there is a Gordian knot in any discussion that attempts to conceptualize creativity in schools and in Mathematics classes. Perhaps this is why Gontijo et

[1] "Exercise intellectual curiosity and use the approach specific to science, including research, reflection, critical analysis, imagination and *creativity*, to investigate causes, develop and test hypotheses, formulate and solve problems and create solutions (including technological ones) based on knowledge from different areas" (Brasil, 2017, p. 9, our emphasis).

[2] We invite the reader to get to know, even if briefly, at least one work by each of these artists: *Cubic division of space*, a lithograph by Escher, from 1952 (Ernst, 2007, p. 47); *Composition VIII*, oil on canvas, painted by Kandinsky in 1923 (Abril, 2011, p. 104-105); *Composition I with Red, Black, Blue and Yellow*, oil on canvas, painted by Mondrian in 1921 (Farthing, 2010, p. 406); *Diagonal function*, a work by Barros, using the enamel on kelmite technique, 1952 (Fainguelernt and Nunes, 2011, p. 43). Regarding Kurasov's works, these will be presented later in the body of the article.

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al. (2019, p. 14-15) argue that "the importance of a discussion about creativity in the field of Mathematics lies in the fact that this discipline is treated, paradoxically, as a difficult area, impossible to learn or, even, exclusive to geniuses". Thus, we escape the obstinate search for a closed concept, which represents the entirety of creativity and its reverberations, to think of possible approximations and unveilings.

What does not fit into this framework are the historically outdated versions that say that creativity would have its "origin in a mystical approach that considered it a divine gift or a present from a spiritual entity, which endowed some individuals with a superior condition of creative power" (Gontijo et al., 2019, p. 19). Or that it is always a manifestation of human madness, "something that man could not control and that would be impossible to measure" (Faria et al., 2018, p. 22).

Everyone has a creative potential that can be further developed.

> The subjective characteristics that participate in the creative expression of the subject are constituted and developed throughout the course of his/her life story based on the relationships that he/she establishes in his/her different social contexts of actions and relationships. Therefore, the school space becomes an essential space in the constitution of the personal characteristics that intervene in the subject's capacity to express himself/herself creatively. The recognition of this reality suggests the need to plan intentional educational actions that contribute to developing these personal resources and, consequently, developing the subjects' possibilities for creative expression (Martínez, 2002, p. 191).

Morais (2015) presents other elements for us to think about: the constitution of a creative person is not something unrelated to the construction of their own personality.

> Of course, having personality does not guarantee being creative. The opposite, however, is true: being creative implies having characteristics such as autonomy, self-confidence, tolerance to ambiguity or persistence. There is no creativity without autonomy, as this allows for individuality, the uniqueness of the project and creative people normally believe more in themselves, with self-confidence being a protector against risks that creative traits may imply (Morais, 2015, p. 4).

Furthermore, creativity cannot be thought of only as being linked to students' attitudes and skills: we also need to invest in the training of creative teachers. The characteristic trait of this teacher is to be a provocateur of their students' creativity, while at the same time being bold and curious, flexible to suggestions, providing opportunities, protecting and encouraging creative work (Peraça and Montoito, 2023).

> Creative teachers, encouraged by a creative school, can enhance their students' creative thinking. Knowing that a student spends a large part of the day inside an educational institution, this should be a place to cultivate imagination, where people would be prepared for the world and generate new ideas, new opportunities [and also take risks and try out new ways of expressing themselves, of being in the world, of living] (Peraça and Montoito, 2023, p. 2).

Morais (2015) comments that, in common sense, creativity is associated with an insight,

popularized in comic books and advertisements by a light bulb that suddenly turns on over the agent who had the idea. Despite this, the author states that insight only happens after intense work and persistence in the face of different information and knowledge that are integrated, which is why being creative is

> mastering knowledge [...]. Now, to make associations of information, it is necessary to possess it. In order to create, it is therefore important not only to have in-depth knowledge about the domain in which one creates, but also multidisciplinary knowledge — and this not only considering high creativity, but also creation in everyday life (Morais, 2015, p. 4).

Contemporary research indicates that creativity is "a complex, multifaceted and heterogeneous process, with different forms and levels of expression, whose existence depends on very diverse conditions and the existence of other complex psychological processes" (Martínez, 2002, p. 190). According to Lubart (2007, p. 17), "creativity requires a particular combination of relevant factors of the individual, such as intellectual capacities and personality traits, in addition to the environmental context". It is, therefore, a "sociocultural process and not just an individual phenomenon" (Alencar and Fleith, 2003, p. 16).

These points of view highlight the importance of seeing — as well as thinking and planning — school (in general) and Mathematics classes (in particular) as environments that instigate the creation of ideas and that provide appropriate techniques for the development of the student, because every human being, to one degree or another, has creative potential.

What seems to happen is that, unfortunately, "in most people, the development and expression of these skills have been blocked and inhibited by an environment that encourages fear of ridicule and criticism" (Alencar and Fleith, 2003, p. 9). This role of something or someone that constrains impulses of creative potential can no longer be the role of school or teacher — in fact, it never was, although it was recurrent.

On the contrary: since school is one of the main spaces for children and young people to experience and socialize, it is essential that it becomes a privileged place for pedagogical work that favors the development of creativity (Gontijo et al., 2019). In the specific case of Mathematics, Muniz (2009) apud Gontijo et al. (2019, p. 60) argues that "mathematical situations need, preferably, to be of a varied nature, so that the student can demonstrate their knowledge and ability in Mathematics not only through the operation of algorithms, but also through texts, graphics or multimedia actions" — it is not on the author's list, however, we understand that artistic expressions could also be part of the list of options presented.

> The importance of creativity in the school context is increasingly recognized, as is the need to develop strategies and actions to stimulate and develop it. However, despite the increase in scientific production on creativity and innovation and the numerous practical experiences with encouraging results, creativity and innovation do not currently constitute real values in most educational institutions. This is clearly expressed in the gap between an accepted discourse, in which creativity is valued, and a reality in which creativity does not achieve, with exceptions, significant expressions (Martínez, 2002, p. 190).

This article aims to *inspire* teachers and mathematics educators to venture into a dialogue between Mathematics and art as a pedagogical proposal to encourage the development of creativity in their students. We seek to demonstrate that, in addition to problem-solving,

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software activities, and approaches through mathematical modeling, art can contribute to the development of creativity, according to the aspects listed by Gontijo (2007): fluency (abundance or quantity of different ideas produced on the same subject), flexibility (ability to change thinking or conceive different categories of answers), originality (presentation of infrequent or unusual answers), and elaboration (presentation of a large amount of details in a single idea).

To conclude this section, it is imperative to recall that, along the way, we abandoned the idea of a concept that encompasses everything that the word *creativity* expresses. This does not mean that we disregard the elements that the Greek definition, cited above, brought, but that we will extrapolate the vernacular to consider, beyond what creativity *is*, what it produces in the *subject and how it is produced by him, via art* — especially from the perspective of insurrection.

3 Approaches between art and Mathematics

This section is divided into two parts: in the first, we present the idea of art as insurrection, that is, as a way of being in the world that stands as a force against the bureaucratization and pasteurization of life; in the second, we present some ideas about Artificial Intelligence, a topic that is beginning to be discussed with greater attention in the field of Education.

The relevance of these parts lies in the fact that, later, they will be united in the suggestion of a pedagogical activity that mixes mathematics and art, designed for the classroom.

3.1 Art as insurrection

The difference between a tree and a man is that men run while trees grow
(Vergani, 2003, p. 22).

Bringing art and Mathematics closer together with pedagogical intentions is nothing new. We can cite countless beautiful studies, such as that of Zaleski Filho (2013), Fainguelernt and Nunes (2006, 2009, 2011), Souza (2018), Gesser, Flores and Schuck (2019), Paulino, Santos and Oliveira (2021) and Vale (2017), among many others. We believe that these and others that the reader may find are sufficiently strong testimonies to defend the pedagogical potential of bringing these two areas of knowledge closer together — something that we will not dedicate ourselves to in this text because we understand that it is already a passive subject in the field of Mathematics Education.

We are interested in thinking about the communion between art and mathematics as an *insurrection*. But what does that mean? To rebel against what? To begin with, against the ideas, also common sense, that mathematics is always associated with accuracy, with the progress of science, with practical application, with problem-solving, with improving the population's quality of life, with the control and security of finances, with unquestionable numerical and statistical data. No one disputes the fact that mathematics is present in these matters, but it is also/can be an artistic inspiration for poetry, architecture, and painting. As Álvaro de Campos, Fernando Pessoa's heteronym, wrote: “There are few people who notice this”[3] (Pessoa, 2015, p. 1290).

One of the reasons, if not the main one, why there are few people who notice this is the unbridled pace at which we live in postmodern society. Han (2021), a Korean philosopher of

[3] The aforementioned verse is part of this poem:
Newton's binomial is as beautiful as the Venus de Milo.
There are few people who notice it.
ooooo — oooooo — oooooo
(The wind outside).

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our time, warns that the acceleration of current times prevents us from contemplating life. There is a constant bombardment of digital information and images, which "are constructed in such a way that it is no longer possible to close your eyes. There is an immediate contact between them and the eye, which does not allow for any contemplative distance" (Han, 2021, p. 16).

Daily life is lived at a frantic pace that, increased by consumption and capitalism (Bauman, 2008), makes it extremely difficult for individuals to have experiences that shape sensitivity and ethics (Larrosa, 2022). It is not uncommon for the school environment itself to contribute to "shaping future consumers of irresponsible and self-interested production" (D'Ambrosio, 2016, p. 230).

It is at this point that we return to the epigraph of this section, part of a poem by the Portuguese theologian and researcher in Mathematics Education Teresa Vergani. Humans are running wildly when they could — or should, at least sometimes — stop to develop better, just as trees do in nature. This redefinition of time is contemplated in the proposal that we present, through art, for Mathematics classes: slowing down, recovering a non-sickening relationship with time, playing at being an art-naut.

> The concept of ArteNauta = Art + Nauta (Journey) has been developed by Amílcar Martins[4] in the context of training Art Educators and/or Artists interested in Education, understood from the perspective of artistic, pedagogical and didactic intervention lato sensu and transformative citizenship. For Martins, Education is understood from the perspective of providing formative Journeys capable of triggering the enjoyment and readings of the world, to which the Learning Subjects themselves will attribute personalized senses and meanings (Alexandrino, 2017, p. 14).

The accelerated pace has reconfigured time, which has gone from being extensive to pointillist: it is not even continuous, as it is sometimes a collection of short experiences that, unfinished or abandoned, are replaced by new emergencies, configuring what Han (2020) called the *Society of Fatigue*. In his work, the philosopher says that we are moving rapidly towards a Doping Society, given that the consumption of anxiolytics by the population is increasing more and more. Resisting these new practices, already assumed as normal, is the central idea that underpins the ode to insurrection. An insurrection that art can carry out against the pimping of life, and of the current neoliberal education plans.

It is Rolink (2019, p. 22-23) who warns about this:

> If the basis of the capitalist economy is the exploitation of labor power and the cooperation intrinsic to production in order to extract surplus value from them, this operation — which we can call "pimping" to give it a name that more accurately reflects the frequency of vibration of its effects on our bodies — has been changing shape with the transfigurations of the regime over the five centuries that separate us from its origin. In its new version, it is life itself that capital appropriates; more precisely, its power of creation and transformation in the very emergence of its impulse — that is, its germinal essence — as well as its cooperation on which such power depends for its singularity to be realized. The vital force of creation and cooperation is thus channeled by the regime so that it can build a world according to its designs. In other words, in its new version, it is the very drive for individual and

[4] Amílcar Martins is a Portuguese art educator whose works are mostly linked to storytelling, theater and play. However, his concept of ArteNauta extends to educators who intend to develop educational experiences through art, as presented in this article through the paintings of Georgy Kurasov.

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> collective creation of new forms of existence, their functions, their codes, and their representations that capital exploits, making it its engine. It follows that the source from which the regime draws its strength is no longer just economic, but also intrinsically and inseparably cultural and subjective — not to mention ontological —, which gives it a perverse power that is broader, more subtle and more difficult to combat (Rolink, 2019, p. 32-33).

It is no wonder that several philosophers point to art as a form of resistance, of being in the world and even of survival. Nietzsche (2012, p. 197), for example, is categorical in stating that "all art, all philosophy can be seen as medicine and relief, at the service of life that grows and struggles[5]" and, therefore, "art acts as therapy for the recovery of strength" (Feiler, 2021, p. 208) that routine insists on depleting.

For Nietzsche, art is a necessity of human existence, which is one of the reasons why "art is more valuable than truth" (Nietzsche, 1974, p. 36). Its primary role is not to entertain, contrary to what common sense suggests, which usually attributes to Art Education classes moments for students to relax from the harshness of other subjects. The philosopher is blunt in defending art:

> Art and nothing like art! It is the great enabler of life, the great seductress of life, the great stimulant of life... Art as the only superior opposing force, in opposition to every will to deny life; anti-Christian, anti-Buddhist and anti-nihilist par *excellence*. Art as the redemption of those who know, of those who see and want to see the fearful and problematic character of existence [...]. Art as the redemption of action, of those who not only see the terrible and problematic character of existence, but rather live it and want to live it, of the man who is a tragic warrior, of the hero (Nietzsche, 2008, p. 427).

Life, from Nietzsche's perspective, is a constant creation and recreation without a predefined teleology (Brandão, 2020). Thus, art is what best expresses what life is, since it is precisely a process of creation and recreation without a purpose beyond creation itself. From the artist's perspective, art is always unfinished and, therefore, he never stops creating, "it is as if the artist somehow captured what life is, and revealed this in his art and in the process of creation" (Brandão, 2020, p. 195).

Following Nietzsche, Zordan (2005, p. 262) emphasizes that "art is a practice that composes existential landscapes, creates a territory, a locus of life where intense virtual images mix with the vectors of concrete and extensive matter". In other words, it is everything that the rush of postmodern everyday life tries to inhibit. We emphasize that, when we defend a rapprochement between art and Mathematics,

> what is important for the educational field is the role that art has in the learning process. Without the sensitive capture of material signs and their transmutation — the rediscovery of lost time, of the mundane and deceptive time that has passed — one cannot learn. Not learning means that one cannot make art in life (Zordan, 2005, p. 264).

Thus, the proposal we present is based on a few ambitions: to open spaces for creativity in Mathematics classes through art; to improve the attitudes of a creative teacher; to encourage the development of students' creativity; to reestablish a healthier relationship with time; to rise

[5] Aphorism number 370.

up against the pimping and trivialization of life; to demystify the discourses that place Mathematics only in the field of exact sciences and scientific advances; to be an ArteNauta in Mathematics; to invent (oneself) and (oneself) to reinvent oneself.

However, we do not wish to diminish the importance, content or applications of Mathematics; on the contrary, we aspire to fill the gaps and cracks, discussing possibilities for it to also be material for artistic production and, consequently, other ways of being in the world. In the case of this proposal, we chose to indicate the use of Artificial Intelligence (AI) as a way of thinking, together, about this practice and awakening greater interest in students. Regarding the teacher, the activity can help him/her to have his/her first contact with AI and, if necessary, lose the fear – raised in some speeches (Quadros, 2024).

3.2 Artificial Intelligence as a generator of insurgent creative images

The presence of AI is not something new, but it has taken on different proportions as access to different resources, search assistants and programs that use AI become more popular in contemporary times. Isaac Asimov, a mathematician and renowned writer of scientific literature, drew attention to the potential and limitations of AI back in the 1970s, whose advancement is achieved through the machines' manipulation of not only numbers, but also symbols that represent knowledge. In this sense,

> the rules for combining these symbols replace traditional methods of numerical information processing (algorithms). Thus, machines can be led to simulate intelligent behavior, using procedures similar to exploratory research. Games involving logic were the first experiments in this area. It is possible, for example, to include in a program the tens of billions of combinations that a game of chess can present. Therefore, from any position, the computer must be able to examine sequences of moves that it has never "seen" and perform new, unforeseen operations. In any case, this is merely a mimicry of intelligent behavior (Asimov, 1992, p. 135)[6].

Recently, the World Commission on Ethics of Scientific Knowledge and Technology (COMEST) defined AI as "machines capable of imitating certain functionalities of human intelligence, including perception, learning, reasoning, problem-solving, linguistic interaction and, however, the production of creative works" (UNESCO, 2021). We note that the idea of human imitation remains.

Is AI capable of going beyond the mimicry of intelligent human behavior? Regardless of the answer, the central problem is not this, but enters the moral, ethical and aesthetic field. The fact is that AI has become just another technology to be used, mastered, manipulated, without necessarily being accompanied by an exercise in reflection on the implications of its use, or impacts for good or for bad, whether in school or outside it. Thinking about the use of AI to develop creativity in Math classes in connection with the arts, without violating Human Rights, is necessary. Therefore, we have made some moves in this direction, developing and proposing activities in undergraduate and graduate courses, with professors who teach Mathematics.

AI produces images from the connections it establishes with the different networks of information, data and images available on the Internet. At this very moment, as the reader reads these lines, different AIs are learning to identify visual patterns and generate new image compositions, for different purposes and with different levels of quality. These images, in some way, express what is circulating in the *virtual neural networks* to which the AI has access and

[6] The quote is presented appears in the book in the form of a footnote.

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can provide interesting indications about what is circulating about Mathematics and art, for example.

Virtual neural networks simulate living cells that behave — due to the way they are interconnected — in a way that none of them would behave if considered in isolation, and are capable of developing *cognitive strategies* and finding non-programmed solutions based on connections they establish with a relatively large number of elements (Coucht, 2009).

It is interesting to note that images that are freely accessible and produced by AI, such as Bing, Canva, etc., tend to be visually cluttered, with an excess of elements and intense color palettes — the result of a process that reveals ongoing machine learning. Despite these aesthetic limitations, images produced by AI can help students and teachers learn about, reflect on, and think about the different ways in which Mathematics has been present in the world over time. A simple and interesting exercise is to ask an AI to produce images based on some keywords that surround a topic of interest, allowing it to develop possible connections from the immense amount of information and images to which it has access.

From the prompt *to create an image with mathematical elements in the works of art by [...]*, we asked Microsoft Bing's AI to generate images in which mathematical elements could be observed in the works of Mondrian, Salvador Dali, Almada Negreiros and Paul Klee. All of these artists explore geometric elements in their paintings, but how does the AI perceive and compose with them? To think a little about this, we selected the images shown in Figure 1, which were produced on October 2, 2024, between 7:00 p.m. and 9:00 p.m.

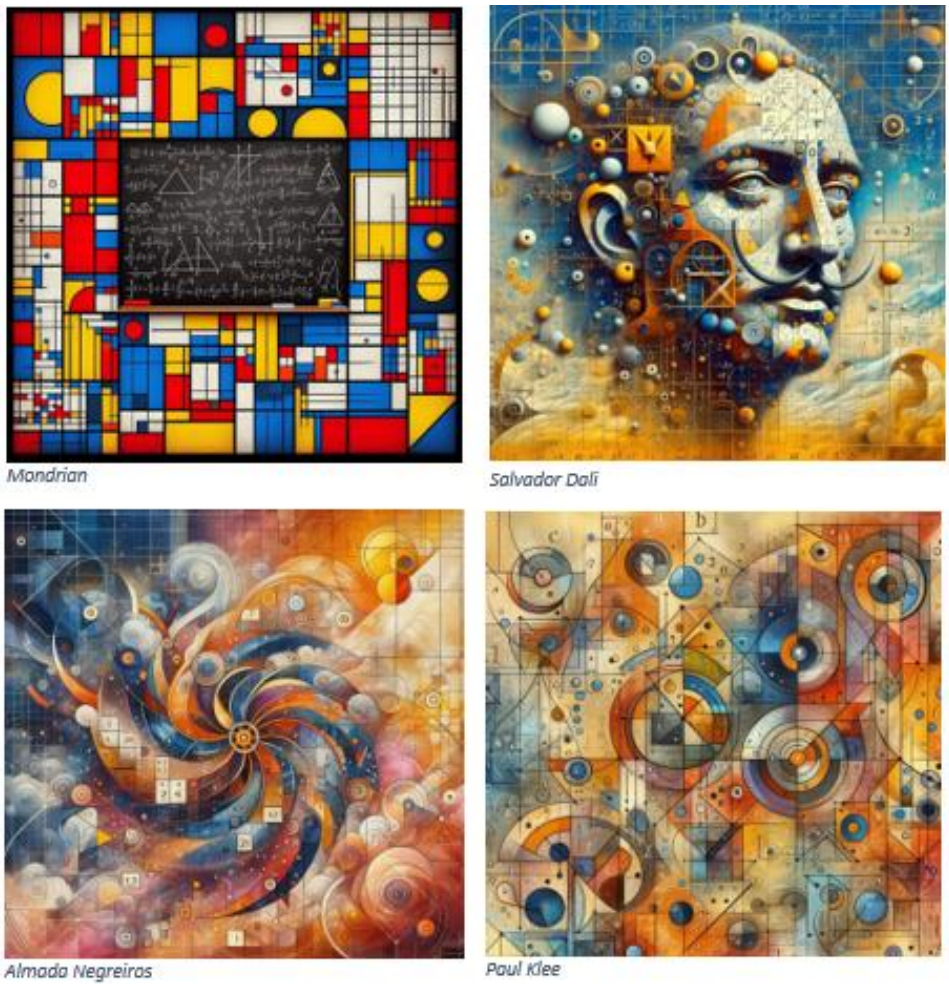

Figure 1: Composition of AI-generated images

In each case, the AI generated four images, and those that presented elements that most

closely resembled the works produced by the respective artists were selected. It is possible to see direct links, such as the primary colors, which are constant in Mondrian's paintings (top, left), and Salvador Dali's own face, inserted in the image (top, right). Furthermore, traces and marks of the paintings of the respective artists are noticeable.

However, it is necessary to analyze them critically, based on knowledge already built through the teacher-student relationship: it is not the case that we should take the images generated by the AI as always being excellent representations of the requested prompt. In this specific case, it is clear that the AI has not yet fully appropriated Mondrian's works (since it created an image with circles, which does not appear in his works), nor those of Negreiros or Klee, since it generated images that have a color palette that does not match the hues frequently used by these painters.

From these considerations, based on the images created, interesting and important discussions can be promoted in the classroom. These activities enhance the development of perception, visuality, the identification of patterns and shapes and promote, even if minimally, the beginning of a visual-aesthetic education. Furthermore, based on these four images, others can be generated, in 3D for example, so that the level of complexity increases and new mathematical elements can be perceived.

The experience in question involves humans and AI interacting and creating together, since the ones who define the prompt — what to highlight or hide — are the AI users themselves. More than consumers, users have an infinite number of creative possibilities at their disposal. This ends up generating the need for directions, choices and filters, *refining* a creative process that encourages them to learn more about the artists and their productions, their painting styles, the context in which the works were produced, among other aspects. It is also important to use imagination, putting the *image* into *action* to propose the repetition of the prompt, *refining* the results presented: when we insert new, more specific information, the image is (trans)formed into a new image.

This exercise of creation and (re)creation, typical of the artistic experience, is also present in the understanding of a mathematical concept. This is an exercise in insurrection, as it requires that time be dedicated to experimenting — which, as already seen, goes against the extremely fast pace of everyday life, to which we are compelled daily.

4 A proposal based on the works of Georgy Kurasov

In addition to the mathematical features present in Georgy Kurasov's paintings, discussed below, we chose to work with this painter because he is contemporary. Introducing him to students can help demystify the idea that the History of Art is a thing of the past and that today it is no longer possible to produce art in a creative and original way, nor to achieve recognition.

Georgy Kurasov is a Russian visual artist who works with sculpture and painting — the latter is the one highlighted in this section. The artist was born in 1958, in Saint Petersburg (Russia), where he still lives and works. Kurasov began studying art at the age of 13, when his mother took him to the Art School that belonged to the Academy of Art. “At the interview it was politely explained that there was nothing for Georgy in the painting department since he had a total lack of feeling for colour. So they suggested Georgy Kurasov join the sculpture class” (Kurasov, [n.d.]).

Later, in 1977, Kurasov enrolled in the sculpture course at the St. Petersburg Academy of Arts, where he remained for 6 years. According to Nassif (2012), it was due to political changes in his country that Kurasov began to make small paintings as souvenirs for foreign tourists, which helped him to maintain his family’s financial survival. Kurasov’s first painting

exhibition took place in 1993, in the United States, and since then, his works have been sold almost exclusively in that country (Nassif, 2012).

On the websites that present Kurasov's works, there seems to be no consensus on which strand of Art History his paintings most closely align with. Brazilian illustrator and designer Lima Júnior (2012) states that they "mix the figurative style of Art Deco[7] with Cubism[8]", while Cole (2021) identifies in them elements of neoconstructivism[9], mobilized by the painter to portray

> men and women in fragmented form. Not only does this approach distort his subject's bodies into extreme proportions, but it also creates a surreal sense of space. The slivers of different colors construct a warped perspective in which objects are flattened until they appear two-dimensional. Altogether, these stylistic choices make each one of Kurasov's paintings a mesmerizing experience (Cole, 2021).

The representation of the masculine appears less frequently in Kurasov's paintings; most of his canvases show "women that vibrate with energy and color. These dynamic pictures are reminiscent of images seen through a kaleidoscope as each cool-faced figure is rendered using an array of saturated geometric shapes" (Cole, 2021). Each of his representations is an "interesting and creative" (Lima Júnior, 2012) mix of a "bold color palettes and geometric shapes" (Cole, 2021).

It is, undeniably, the geometric shapes that draw the attention and sensitize the observer's gaze, right from the first contact with a painting by Kurasov. As with the great names in the History of Art, his works have the particularity of — once his style is known and unraveled — being automatically and unequivocally attributed to him. Among them, we present four that touch us in a particular way.

Starting with the top left image and moving clockwise, we number and present Kurasov's paintings:

(1) *Wounded Amazon II*, oil on canvas, 101 × 101 cm; painted in 2016;

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[7] "The term art deco, of French origin (abbreviation of arts décoratifs), refers to a decorative style that was popular in the visual arts, applied arts (design, furniture, decoration, etc.) and architecture in interwar Europe. The landmark in which the '1920s style' began to be conceived and named was the International Exhibition of Modern Decorative and Industrial Arts, held in Paris in 1925. Art deco is originally linked to art nouveau. Derived from the tradition of applied art that dates back to England and the Arts and Crafts Movement, art nouveau explores sinuous and asymmetrical lines with plant forms and floral ornaments as its fundamental motifs. The art deco decorative pattern follows another direction: stylized straight or circular lines, geometric shapes and abstract design predominate. Among the most explored motifs are animals and feminine forms" (Enciclopedia, 2017).

[8] "An artistic movement that dates back to Paris and 1907, the year of Pablo Picasso's famous painting, Les Demoiselles d'Avignon. Considered a watershed in the history of Western art, Cubism rejects the idea of art as an imitation of nature, rejecting notions such as perspective and modeling, as well as any type of illusory effect. 'One does not imitate what one wants to create', says Georges Braque, another exponent of the movement. The plastic reality announced in Braque's compositions led the critic Louis Vauxcelles to speak of reality constructed with 'cubes', in the newspaper Gil Blas, 1908, which gave the new movement its name. Cubes, volumes and intersecting geometric planes reconstruct shapes that appear simultaneously from various angles on the canvases. The space of the painting — the plane on which reality is recreated — rejects distinctions between form and background or any notion of depth" (Enciclopedia, 2018).

[9] "Constructivism in art was the last and most important Russian modern art movement of the 20th century. It began in 1915, but gained momentum two years later, with the Russian Revolution. Its evolution was therefore completely tied to politics, more precisely to communism. Despite being influenced by other European avant-gardes, such as cubism and futurism, constructivist art had completely innovative ideas and narratives. Constructivism in art was a movement that sought to break with the traditional artistic concern of composing works guided by aesthetics, replacing this idea with construction, combining industrial images and geometric compositions. Constructivism in the visual arts denied the decorative role of art and praised modernity and the use of advanced techniques. The artists of the movement did not aim at mere expression, but rather to compose pieces that reflected the modern industrial world and that acted as a dissemination of the ideas of the communist revolution" (Papoca, 2021). Neoconstructivism is a later revival of this movement.

(2) *Tango*, oil on canvas, 104 × 79 cm, painted in 2014;

(3) *A Dream*, oil on canvas, approximately 102 × 102 cm, painted in 2001;

(4) *The Birth of the Myth*, giclée[10] on canvas, approximately 97 × 97 cm, 2020.

Figure 2: Composition of four canvases by Georgy Kurasov[11]

It is easy to see the presence of straight lines that serve as contours for the painted forms and, often, soften the curves of the human body or objects. Sometimes, a set of straight lines forms a polygon that completely or partially encloses the depicted figure, as in the torso and leg of the dancers, which are enclosed in a quadrilateral (work 2) or the body of the sleeping girl, also enclosed in a quadrilateral from which only the right leg escapes (work 3). Straight lines also divide the paintings into areas of interest: two parallel horizontal lines divide work 4 into three parts of unequal measurements (from the sky to the woman's arm; between the woman's arms; from the woman's breast to the ground) and a transversal line, in work 3, divides the

[10] *Giclée* comes from the French verb *glicer*, which means to spray, and refers to an artistic technique in which the image is fixed by spraying the support with small drops. In this way, the image is printed with maximum detail.
[11] Available at: http://www.kurasov.com

woman's body into two parts.

Another geometric shape that is easy to recognize is the circumference — or arcs of circles —, which both delimit the contours of the forms and give them movement. In work (1), we see an almost complete circle that encloses the horse's head, its belly, the Amazon's shield and her arm, as well as another arc (turned downwards) that, intersecting the first circle, outlines the woman's leg and the handle of her shield. In work (4), all the most prominent elements are inscribed in a large circle, which touches the ends of the canvas.

Based on these observations, the proposal we present is, in its genesis, very simple. Its steps can be modified or adapted, at the teacher's discretion, and can also be developed in the time he or she deems most appropriate.

Step 1 — Present one or two works by Kurasov to the students, as well as a short biography of the artist. The presentation can be done using material prepared and projected by the teacher or through one of the many videos that can be found on the internet[12].

Step 2 — Divide the class into small groups and ask them to research other paintings by Kurasov; at the end of this step, each group should select a few (the number that the teacher feels comfortable working with in class) and present them to the other groups.

Step 3 — Using tracing paper and placing it over the images that reproduce the chosen works, ask the students to trace, with a ruler, compass and other instruments (if applicable), the mathematical shapes that they can visualize (straight lines, polygons, circles, arcs, etc.). Later, by moving the tracing paper over the image, students will be able to have a *purer* view of the mathematical elements manipulated in the creation of that painting.

Step 4 — Ask the students to create, using AI tools, images that evoke the style of Kurasov's paintings. The number of new images produced per group can vary according to the time that the teacher wishes to dedicate to this activity. It is suggested that this step be an extracurricular activity and that the images be presented in class later.

Step 5 — During the presentation of the new images, group members must not forget to highlight the mathematical elements that make up the work(s) created.

It is worth noting that, in Step 4, the teacher can give students complete freedom to express their creativity, but can also suggest guidelines for creating the image: *the image must contain a pair of parallel lines; the human figure in the image must be entirely contained within a regular/irregular quadrilateral; at least one element of the image must be delimited by a circle; the image must present a set of half-lines that have a common point as their origin, among others.*

In addition to geometric shapes, it may be in the teacher's interest to work, even if only in an underlying way, on the production of images that aim at decolonial education, proposing that students create representations of black bodies or LGBTQIAPN+ bodies, in scenarios that express social issues, attacks on the environment, violations of human rights, women's rights, among others. It is clear, as we discussed in section 2 of this article, that the creativity of the teacher when planning their classes and activities impacts the way in which the student uses their own creativity in the school environment.

By way of conclusion, we return to AI: students could undoubtedly be asked to make freehand drawings inspired by Kurasov's works; so why, in this article, do we suggest the use of AI? Wouldn't freehand drawing be *more creative?* To answer this question, we return to the aspects of creativity that Gontijo (2007) considers important: fluency (abundance or quantity of different ideas produced on the same subject), flexibility (ability to change thinking or

[12] We suggest one of them: https://www.youtube.com/watch?v=PB2og6GFH7s.

conceive different categories of answers), originality (presentation of infrequent or unusual answers) and elaboration (presentation of a large amount of details in a single idea).

The teacher suggests some guidelines for creating an image based on Kurasov's works, which will include: the different representations that each group will present on the same subject (fluency); the way in which a requested quadrilateral, for example, will appear in different ways in different images (flexibility); the illustrations created that satisfy the previously agreed conditions (originality); the variety of works created (elaboration). It is, above all, in this last aspect — that of producing several works to be displayed side by side, forming an attractive set of *Kurasovian canvases* — that AI proves to be a powerful ally in the exercise of creativity.

4 Final considerations

Throughout this theoretical essay, we have presented the topic of creativity for discussion. While we do not seek to find an exact definition for it in the above, we do, on the other hand, encourage an understanding of what it produces as a way of being in the world.

Creativity — which is present in all individuals and can be increasingly developed by them as they experience cultural and personal experiences — cannot be ignored in school practices. In the specific case of Mathematics, one way to help students develop their creativity is to think of activities that put this subject in contact with art.

From this perspective, we present a proposal for an activity based on the paintings of Russian artist Georgy Kurasov, with the aim of making some of the ideas discussed more tangible. However, as previously highlighted, we expect the teacher to establish himself as a bold and creative being, taking the risks of his own inventiveness, which may lead him to modify the activity significantly or choose another painter to work with his students.

The most important thing about the proposal we present is that we do not use art as an object to be taught, that is, it is not reduced to a mathematical exercise for the classroom, detaching itself from its creative potential. We long for exactly the opposite: to create, to give free rein to creativity, to do and redo, to throw everything away and start over — if necessary.

We also emphasize that the use of AI cannot be understood as an inhibitor of creativity, or even of critical thinking, since, as commented on from the images it creates, not everything that will be generated will meet the expectations of the students or the teacher. Nevertheless, getting to know it better and losing the fear of it can be a very important step for the teacher who will be in the classroom over the next decades. In the sense of the above, the text brought elements that achieve the main objective, which was to discuss the exercise of creativity in mathematics classes through art, not in relation to a closed concept, but giving vent to creativity as a creative power and as a way of being in the world.

As a theoretical essay that, as highlighted at the beginning of this article, is articulated around a theoretical discussion whose purpose is to defend, rationally and logically, a point of view or an idea, we defend art as an insurrection against the pimping/banality of life, inviting the student, in mathematics class, to an aesthetic exercise, to express themselves creatively in the world, to break with the accelerated pace of productivity.

And, without the intention of exhausting the subject, we hope that reading this article will invite other teachers to reflect, both theoretically and empirically, on the connections and possibilities presented.

References

ABRIL. *Grandes mestres – Kandinsky*. São Paulo: Abril, 2011.

ALENCAR, Eunice Soriano; FLEITH, Denise de Souza. *Criatividade:* múltiplas perspectivas. Brasília: Editora UnB, 2003.

ALEXANDRINO, Teresa. ArteNautas e Contadores de Histórias: uma prática de Arte e Educação no Colégio Internacional de Vilamoura. *ExperimentArt*, v. 2, n. 4, p. 11-42, 2017.

ALMEIDA, Maria da Conceição. Prefácio — Um alpendre lilás para a Educação. In: FARIAS, Carlos Aldemir. *Alfabetos da alma*: histórias da tradição na escola. Porto Alegre: Sulina, 2006.

ASIMOV, Isaac. *Antologia 2*. Rio de Janeiro: Nova Fronteira, 1992.

BARBOSA, Gustavo. Criatividade e o conhecimento matemático no *Íon*, de Platão. *Zetetiké*, v. 31, p. 1-19, 2023. http://doi.org/10.20396/zet.v31i00.8672174

BAUMAN, Zygmunt. *Vida para consumo:* a transformação das pessoas em mercadoria. Tradução de Carlos Alberto Medeiros. Rio de Janeiro: Zahar, 2008.

BOAVA, Diego Luiz Teixeira; MACEDO, Fernanda Maria Felício; SETTE, Ricardo de Souza. Contribuições do ensaio teórico para os estudos organizacionais. *Revista Administração em Diálogo*, v. 22, n. 2, p. 69-90, maio/ago. 2020. https://doi.org/10.23925/2178-0080.2020v22i2.41951

BORBA, Francisco da Silva. *Dicionário UNESP do Português contemporâneo*. Curitiba: Piá, 2011.

BRANDÃO, Ricardo Evangelista. A arte como expressão da vida como vontade de poder em Friedrich Nietzsche. *Griot*, v. 20, n. 2, p. 190-201, jun. 2020. https://doi.org/10.31977/grirfi.v20i2.1726

BRASIL, Ministério da Educação. Secretaria de Ensino Fundamental. *Parâmetros Curriculares Nacionais:* Matemática: 1º e 2º Ciclos do Ensino Fundamental. Brasília: MEC/SEF, 1997.

BRASIL. Ministério da Educação. Secretaria de Educação Básica. *Base Nacional Comum Curricular*: Educação Infantil e Ensino Médio. Brasília: MEC/SEB, 2017.

BRITO, Arlete de Jesus; DALCIN, Andreia. Fotografia no ensino de Matemática: algumas possibilidades. *Rematec*, v. 17, n. 40, p. 60-73, 2022. https://doi.org/10.37084/REMATEC.1980-3141.2022.n40.p60-73.id504

CARDOSO, Virginia Cardia; PAULO, Rosa Monteiro; DALCIN, Andreia. A beleza matemática: uma proposta pedagógica de sensibilização estética para o ensino da Matemática. *REnCiMa*, v. 5, n. 2, p. 56-74, jul.dez. 2014. https://doi.org/10.26843/rencima.v5i2.840

CARMO, Luana Jéssica Oliveira; ASSIS, Lilian Bambirra; GOMES JÚNIOR, Admardo Bonifácio; TEIXEIRA, Marcella Barbosa Miranda. O empreendedorismo como uma ideologia neoliberal. *Cadernos EBAPE.BR*, v. 19, n. 1, p. 18-31, jan./mar, 2021. https://doi.org/10.1590/1679-395120200043

CARVALHO, Bryan Lucas Marques; DALCIN, A. Matemática e fotografia no Ensino Médio: entre enquadramentos e sombras. In: *Anais do VIII Encontro Nacional do Grupo de Pesquisa História, Filosofia e Educação Matemática*. Porto Alegre, 2023, p. 100-111.

COLE, Margherita. Painter uses geometric shapes to create colorful fragmentations of the human form. *My modern met*, 11 apr. 2021. Disponível em https://mymodernmet.com/georgy-kurasov-abstract-painting/

COUCHT, Edmond. Automatização de técnicas figurativas: rumo à imagem autônoma. In: DOMIGNUES, Diana (Org.). *Arte, Ciência e Tecnologia*: passado, presente e desafio. São Paulo: Editora Unesp, 2009, p. 397-406.

D'AMBROSIO, Ubiratan. *Educação para uma sociedade em transição*. São Paulo: Livraria da Física, 2016.

DE TOMMASI, Livia. Juventude, projetos sociais, empreendedorismo e criatividade: dispositivos, artefatos e agentes para o governo da população jovem. *Passagens*, v. 6, n. 2, p. 287-311, maio/ago. 2014.

DEL PUPPO, Alessandro. Dalí e o surrealismo. In: ABRIL. *Grandes mestres – Dalí*. São Paulo: Abril, 2011, p. 10-36.

ENCICLOPEDIA ITAÚ CULTURAL. *Art Déco* [verbete]. 2017. Disponível em https://enciclopedia.itaucultural.org.br/termo352/art-deco

ENCICLOPEDIA ITAÚ CULTURAL. *Cubismo* [verbete]. 2018. Disponível em https://enciclopedia.itaucultural.org.br/termo3781/cubismo

ERNST, Bruno. *The magic mirror of M. C. Escher*. Köln: Taschen, 2007.

FAINGUELERNT, Estela Kaufman; NUNES, Katia Regina Ashton. *Descobrindo Matemática na Arte:* atividades para o Ensino Fundamental e Médio. Porto Alegre: Artmed, 2011.

FAINGUELERNT, Estela Kaufman; NUNES, Katia Regina Ashton. *Fazendo Arte com a Matemática*. Porto Alegre: Artmed, 2006.

FAINGUELERNT, Estela Kaufman; NUNES, Katia Regina Ashton. *Tecendo Matemática com Arte*. Porto Alegre: Artmed, 2009.

FARIA, Ana Catarina; PERNETA, Andreia Filipa; TEIXEIRA, Carlota M.; FELIX, Francisca F. A complexidade da criatividade. In: POCINHO, Margarida; GARCÊS, Soraia. (Org.). *Psicologia da criatividade.* Funchal: Universidade da Madeira, 2018, p. 20-46.

FARTHING, Stephen. *Tudo sobre arte*: os movimentos e as obras mais importantes de todos os tempos. Rio de Janeiro: Sextante, 2010.

FEILER, Adilson Felício. Nietzsche e a arte como terapia da cultura: como opor resistência, para a superação em tempos de pandemia. *Dissertatio*, v. 54, p. 189-211, 2021. https://doi.org/10.15210/dissertatio.v54i.19391

GESSER, Gabriel José; FLORES, Cláudia Regina; SCHUCK, Cássia Aline. Matemática e arte cubista: sobre uma experiência com crianças no ensino fundamental. *Ensino e Multidisciplinaridade*, v. 5, n. 1, p. 1-17, jan./jun. 2019.

GONTIJO, Cleyton Hércules. *Relações entre criatividade, criatividade em Matemática e motivação em Matemática de alunos do Ensino Médio*. 2007. 206f. Tese (Doutorado em Psicologia). Universidade de Brasília. Brasília.

GONTIJO, Cleyton Hércules; CARVALHO, Alexandre Tolentino; FONSECA, Mateus Giani; FARIAS, Mateus Pinheiro. *Criatividade em matemática:* conceitos, metodologias e avaliação. Brasília: Editora UnB, 2019.

HAN, Byung-Chul. *Favor fechar os olhos:* em busca de um outro tempo. Tradução de Lucas Machado. Petrópolis: Vozes, 2021.

HAN, Byung-Chul. *Sociedade do cansaço*. Tradução de Enio Paulo Giachini. Petrópolis: Vozes, 2020.

KURASOV. *Kurasov Fine Art*. [s.d.]. http://www.kurasov.com/index.php

LARROSA, Jorge. *Tremores*: escritos sobre experiência. Tradução de Cristina Antunes; João Wanderley Geraldi. Belo Horizonte: Autêntica, 2022.

LIMA JÚNIOR, João. A arte de George Kurasov. *Design Innova*, 3 ago. 2012. Disponível em https://designinnova.blogspot.com/2012/08/a-arte-de-georgy-kurasov.html

LUBART, Todd. *Psicologia da criatividade*. Tradução de Márcia Conceição Machado Moraes. Porto Alegre: Artmed, 2007.

MARTÍNEZ, Albertina Mitjáns. A criatividade na escola: três direções de trabalho. *Linhas Críticas*, v. 8, n. 15, p. 189-206, 2002. https://doi.org/10.26512/lc.v8i15.3057

MENEGHETTI, Francis Kanashiro. O que é um ensaio-teórico? *Revista de Administração Contemporânea*, v. 15, n. 2, p. 320-332, mar./abr. 2011. https://doi.org/10.1590/S1415-65552011000200010

MORAIS, Maria de Fátima. Criatividade: conceito e desafios. *Educação e Matemática*, n. 135, p. 3-7, 2015.

NASIOTIS, Eleni. *Dr. Chandra, Will I Dream? Surreal art and artificial intelligence*. 2019. These (The Honors Program). Baylor University. Waco.

NASSIF, Luis. A arte do russo George Kurasov. *Jornal GNC*, 25 abr. 2012. Disponível em https://jornalggn.com.br/cultura/a-arte-do-russo-george-kurasov/

NIETZSCHE, Friedrich. *A gaia ciência*. Tradução de Paulo César de Souza. São Paulo: Companhia de Bolso, 2012.

NIETZSCHE, Friedrich. *A vontade de poder*. Tradução de Marcos Sinésio Pereira Fernandes; Francisco José Dias de Moraes. Rio de Janeiro: Contraponto, 2008.

NIETZSCHE, Friedrich. *O nascimento da tragédia no espírito da música*. Tradução de Jacob Guinsburg. São Paulo: Abril Cultural, 1974.

ORGANIZACIÓN DE LAS NACIONES UNIDAS PARA LA EDUCACIÓN, LA CIENCIA Y LA CULTURA. *Inteligencia artificial y educación: guía para las personas a cargo de formular políticas*. Paris: UNESCO, 2021.

PAPOCA, Agencla. Construtivismo na arte: o movimento, suas influências e repercussões. *Laart*, 3 mar. 2021. Disponível em https://laart.art.br/blog/construtivismo-arte

PAULINO, Felipe Freitas; SANTOS, Francisco Wilton Moreira; OLIVEIRA, João Luzeilton. O Código Da Vinci e o encontro entre Matemática, História e Arte. *Educação Matemática Debate*, v. 5, n. 11, p. 1-26, 2021. https://doi.org/10.46551/emd.e202107

PERAÇA, Maria da Graça; MONTOITO, Rafael. Criatividade e pensamento criativo: um estudo prático sobre os modelos de Wallas e Hadamard. *Zetetiké*, v. 31, p. 1-17, 2023. http://doi.org/10.20396/zet.v31i00.8671675

PERAÇA, Maria da Graça; MONTOITO, Rafael. História da Matemática no curso de Comunicação Visual: um projeto sobre a matemática maia. In: *Anais do XI Seminário Nacional de História da Matemática*. Natal, 2015, p. 1-11.

PEREIRA, Maurício Fernandes; ARAÚJO, Pedro da Costa; CRUZ JÚNIOR, João Benjamin; RIBEIRO, Fernanda Pimentel. Empreendedorismo e criatividade: uma análise crítica dos alunos formados em Administração à luz da percepção dos dirigentes. In: *Anais do XIII Simpósio de Engenharia de Produção*. Bauru, 2006, p. 1-12.

PESSOA, Fernando. *Obra poética completa*. Lisboa: Editora DC, 2015.

QUADROS, Paulo da Silva. *Quem tem medo da inteligência artificial?* Jornal da USP, 7 out. 2024. Disponível em https://jornal.usp.br/?p=812507

ROLINK, Suely. *Esferas da insurreição*: notas para uma vida não cafetinada. São Paulo: N-1 edições, 2019.

SILVA, Júlio César Leite. Empreendedorismo: explorando novas fronteiras com inovação e criatividade. *Revista Tópicos*, v. 2, n. 12, p. 1-20, 2024. https://doi.org/10.5281/zenodo.13324532

SOARES, Sandro Vieira; PICOLLI, Icaro Roberto Azevedo; CASAGRANDE, Jacir Leonir. Pesquisa bibliográfica, pesquisa bibliométrica, artigo de revisão e ensaio teórico em Administração e Contabilidade. *Administração: Ensino e Pesquisa*, v. 19, n. 2, p. 308-339, maio/ago. 2018. https://doi.org/10.13058/raep.2018.v19n2.970

SOUZA, Jéssica Juliane Lins. *Traços surreais no encontro com Salvador Dalí e crianças e Matemática e oficina*. 2018. 71f. Trabalho de Conclusão de Curso (Licenciatura em Matemática). Universidade Federal de Santa Catarina. Florianópolis.

VALE, Isabel. Matemática e Arte: uma conexão a explorar no ensino da Matemática. *Diálogos com Arte*, n. 7, p. 223-242, 2017.

VERGANI, Teresa. *A surpresa do mundo*: ensaios sobre cognição, cultura e educação. Natal: Editorial Flecha do Tempo, 2003.

ZALESKI FILHO, Dirceu. *Arte e Matemática*. Belo Horizonte: Autêntica, 2013.

ZORDAN, Paola. Arte com Nietzsche e Deleuze. *Educação & Realidade*, v. 30, n. 2, p. 261-272, 2005.