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The Case of a Mathematics that Speaks of the Body that  
One Notices. Or, the Body that One Notices with the Art  
and Speaks of Mathematics

O Caso de uma Matemática que Fala do Corpo que se Olha.  
Ou, o Corpo que se Olha com a Arte e Fala de Matemática

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**ABSTRACT**

This article is an exercise in thinking about what constitutes us. It is a philosophical and critical stance on what we are. Therefore, the objective and material existence of specific rules that mathematics makes us obey and follow when we participate in a speech is problematised. For that, specific ways of looking at and representing the human body move, discussing a discursive practice in which mathematics appears as content, as a matter of study, knowledge, language, thought, and an aesthetic that relates us to the world. So, we understand that, aesthetically, mathematics also exerts relationships of knowledge and power in our education, subjectifying and capturing us, reverberating, as it seems, through an aesthetic of thinking about the world and through the classroom, in which mathematical knowledge stands as a means of talking of and about things.

**KEYWORD:** Philosophy of mathematics. Art and mathematics. Education. Visuality.

**RESUMO**

Este artigo é um exercício de pensamento sobre aquilo que nos constitui. É uma postura filosófica e crítica do que somos. Problematisa-se, pois, a existência objetiva e material de certas regras que a matemática nos impele a obedecer e a seguir quando participamos de um discurso. Para tanto, movimentam-se certos modos de olhar e representar o corpo humano, ao discutirmos acerca de uma prática discursiva em que a matemática aparece como conteúdo, como matéria de estudo, como saber, como linguagem, como pensamento, mas também, como uma estética que nos relaciona com o mundo. Compreende-se que, esteticamente, a matemática também exerce relações de saber e poder em nossa

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formação, nos subjetivando e nos capturando, reverberando, ao que parece, em uma estética de pensamento sobre o mundo e em sala de aula, em que o saber matemático se coloca como meio de falar das coisas e sobre elas.

**PALAVRAS-CHAVE:** Filosofia da Matemática. Arte e Matemática. Educação. Visualidade.

### Of form and de-form in and of the gaze<sup>3</sup>: an aestheticising mathematics

According to Silva (2007, p. 11), “questions about the nature of mathematical objects and the character of mathematical knowledge have a long history in the course of Western philosophy”. Such questions go back from “Mesopotamia and ancient Egypt, classical antiquity, the Middle Ages, with the contributions of the Arabs, and the Scientific Revolution, to the establishment of rigor in mathematics in the 17th and 18th centuries and pure mathematics in the 19th century” (ROQUE, 2012, p. 13), to the expansion of topology studies in the 20th century, and the advancement of computing in the current century; and much more, about which countless pages have already been written and described. In fact, much has been said of and about mathematics in the light of history and philosophy, permeating its ontological and epistemological bias in different ways and from different perspectives<sup>4</sup>. However, by no means do we claim that everything is already given and said in a ready and finished way. On the contrary, much can still be told and narrated and, above all, thought and problematised.

It is said, more frequently, that mathematics has its “bigger story”, which is told from the famous mathematicians who have leveraged it and have thought about its structure with universal pretension, instituting a unified and rigorous knowledge. This move seems to refer to the idealisation that those enlightened questions echo directly through the mathematics we have, learn, and teach today, through a relationship of evolution and progress, causes, and consequences of knowledge.

On the other hand, and no less important, we can think about and problematise—and this is where we find ourselves— mathematics among its details, which create meanings and give movement to what is formed and transformed (on knowledge and the world), as well as what shapes and transforms us. Temporal truths are arranged,

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<sup>3</sup>We allude to the research project entitled “Formas e de-formas no olhar: por uma educação matemática fronteira e criadora” [Forms and de-forms in the gaze: for a borderline and creative mathematics education], developed by the second author, in the CNPq productivity research modality.

<sup>4</sup>See, for example, the best-known and constantly referenced books in research that work with the history of mathematics: *História da matemática*, [History of Mathematics], by Carl Boyer and *Introdução à história da matemática*, [Introduction to the history of mathematics], by Howard Eves. There are also other books written and published in Brazil: in the field of philosophy, the book *Filosofias da Matemática*, [Philosophies of mathematics], by Jairo José da Silva, and in history, *História da Matemática: umavisão crítica, desfazendos mitos e lendas* [History of mathematics: a critical view, undoing myths and legends], by Tatiana Roque.

productions composed, and discontinuities generate ruptures, gaps, shocks, pulsations, uses, and styles. We speak, therefore, of practices; practices as effects of rules, or rather, we think of the objective and material existence of some rules in which mathematics impels us to obey, follow, and participate. A discursive practice in which mathematics is one of the forms of narrativity. Hence, we discuss practices being exercised, preserved, or modified by the flows and intensities that cross us; practices that constitute and form ways of being in the world, of thinking about the world. Specifically, to introduce this theme aiming at art,<sup>5</sup> we offer some clues to a practice in which mathematics appears as content, subject of study, language, thought, and as an aesthetic of relating to the world.

Therefore, Flores, Machado, and Wagner (2018), using Wittgensteinian tools present in the text “*GECEM in assembly or producing knowledge with a group that studies mathematics education*”, started a discussion about what GECEM<sup>6</sup> makes with math. Subsequently, the authors rummaged around and raised some clues about what we call mathematics in our investigations. The authors argued about *mathematics as a language*, which is part of a family of language games with a family of uses. In other words:

We have the language game of pure mathematics, applied mathematics, school mathematics, carpenter mathematics, everyday mathematics, etc. and the language game of Euclidean geometry, hyperbolic geometry, algebra, or even the painter, architect, engineer, etc. math language game. Each shows an aspect of what we call (what we have learned to call) mathematics, shows one of its applicability and, together, they make up a complex network of similarities (and dissimilarities) that overlap one another (FLORES; MACHADO; WAGNER, 2018, p. 137-138).

When also thinking about language, more precisely, about a *mathematical language*, Cássia Schuck (2021), involved in the discussions presented by GECEM and crossed by Walter Benjamin’s ideas, problematizes representation as a model of knowledge production in mathematics education, bringing semiotic theory to the discussion. With the problematisation, the author sets apart from the movement of thinking about language as *Mittel*, in which language is seen as an organisation of spoken or written signs that aims to transmit some information and approaches language as *medium*, which makes us think and act on the world in a specific way,

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<sup>5</sup>This discussion is part of an ongoing thesis that problematizes: what can mathematics do with art in the classroom? The research is being developed in the Postgraduate Program in Scientific and Technological Education (PPGECT/UFSC) by the first author, under the guidance of the second author.

<sup>6</sup>GECEM stands for Grupo de Estudos Contemporâneos e Educação Matemática [Group for Contemporary Studies and Mathematics Education] ([www.gecem.ufsc.br](http://www.gecem.ufsc.br)), led by Prof. Dr Cláudia Regina Flores and situated at UFSC.

producing meanings and composing particular ethics, aesthetics, and policies (SCHUCK, 2021). Hence, the mathematical language is taken as *allegory*, which implies “taking it together in its historicity, viscosity, narrativity, and, why not, its artistic form of expression” (SCHUCK, 2021, p. 54) to create meanings for mathematical knowledge, and reveal possibilities of meaning, and not just represent and recognise it.

Following the argument of Flores, Machado, and Wagner (2018), mathematics is *normative*, i.e., the propositions of mathematics are constituted in a tangle of rules that indicate directions of conduct and ways of being and staying in the world. This means that, based on the linguistic game of mathematics, “our experiences of the real are organised (from their *normative —arbitrary, imposed— propositions*)” (FLORES; MACHADO; WAGNER, 2018, p. 138, emphasis added). We are not obliged to follow them; however, we act according to them, we act obediently, participating in a given ‘discourse’. In this sense, “mathematics functions, therefore, as a *scheme* [ideal] through which we learn [in our historicity] to look at the things of the world” (FLORES; MACHADO; WAGNER, 2018, p. 138, emphasis added). That said, we think of the hypothesis that, with mathematics, a way of thinking emerges, a form that gives ‘shape’, at first, to our rational thought, and that, later, once mathematised, is done in style through aesthetics and elaborated by concepts and language.

Thus, we think: Is mathematics, in some way, coated with its content and its language, one form among others that informs how we see and think? An aesthetics, but also a politics that relates us to the world and everything in the world? The artist Mel Bochner, for example, realised or, rather —from what he had available for his creations—, diagnosed that some measures that standardise us “are so deeply rooted in our experience that they regulate our perception, and however, they remain invisible” (BOCHNER, 1999, p. 14). In other words, we are constantly being pushed to fit ourselves into specific spaces, weights, sizes, measures, patterns, proportions, and organisations, among others, in the world —also politically. We realise that there is always “a load of thought in what seems to be an anodyne detail” (RANCIÈRE, 2009b, p. 10). As an example, Bochner says that he started using brown paper in his art because, as a practical solution, it was a permanently available material in his studio. However, he says that:

[brown paper] came in formats 91.4 x 121.9 cm, which are the standard measurements for most building materials. [...] This is how 36 and 48 inches (same as 91.4 x 121.9 cm) became the given factors in the *48” Standards* pieces. Brown paper itself was of no aesthetic interest to me



as a material, but as I worked with it, I found that it had very interesting properties. For example, I found that wrapping paper is sold not only in formats but also in standardised weights: 270 g/m<sup>2</sup>, 360 g/m<sup>2</sup>, 400 g/m<sup>2</sup> (BOCHNER, 1999, p. 14).

With this, the artist is open to a new possibility of expression in his art, denouncing how mathematics imposes limitations and regulates standards, giving visibility to what so often goes unnoticed, looking differently from what is seen, and thinking with what is so ingrained in us, in our experience and visual style. For, as Rancière (2009b, p. 36) writes, “the artist is that who travels in the labyrinths or undergrounds of the social world. They pick up the traces and transcribe the painted hieroglyphs in the very configuration of obscure or trivial things. They restore their poetic and significant double potency to the insignificant details of the world’s prose”.

And, from our work with art, we understand that the mathematical knowledge that reverberates,

[...] has not emerged as an empirical or transcendent object [...], but as knowledge, as a way of thinking that [also] organises the pictorial space, shapes painting, modulates thought; as a discursive materiality that shapes and gains effects through the artist’s work, shapes us, and informs our visual codes and rules (FLORES; MACHADO; WAGNER, 2018, p. 139).

Thinking about it incites us; for example, as already mentioned, thinking about mathematics as aesthetics, which, in its language and use, constitutes a way of life, a way of speaking, thinking, and acting in the world (FLORES, 2017). When referring to aesthetics, we are not talking about a general theory of art to apply it, in some way, to mathematics or about the effects of aesthetics on sensibility. That is, we are not talking about an aestheticisation of mathematics aiming to seek its intrinsic beauty to develop the taste and pleasure for mathematics, a aesthetic education of mathematics; or yet, an aesthetics of the sensitive in mathematics linked to sensitivity about the visual aspects present in mathematical concepts, in which there is “an aesthetic content in mathematics, and this content is linked to what can be ‘perceived’ by the intellect. [...] They are aesthetic values of mathematics, for example, perfection, symmetry, form, context, contrast, order, balance, simplicity, abstraction, and freedom” (CIFUENTES, 2005, p. 58, emphasis added). An example of this approach is the aesthetics given to the *infinite*, according to Cifuentes (2005), who, based on Kant, argues that:

[...] infinity is the nexus between mathematics and art (!), it is the nexus between mathematics and aesthetics, rationality and beauty; it is the bridge between scientific knowledge and the aesthetic knowledge of mathematics, understanding by aesthetic knowledge the sensitive knowledge through mathematical intuition and beauty (CIFUENTES, 2005, p. 60).

However, in another sense, we speak of aesthetics as a form, or rather, in the wake of Rancière, we think that we understand aesthetics as “a way of thinking that is developed about things [...] and that seeks to say that they consist as things of thought” (RANCIÈRE, 2009b, p. 12). That is why we consider a thought that is willing to operate, some way of life and a way of relating to the world, which leads us to “a way of articulating ways of doing, forms of visibility of these ways of doing and modes of thinkability of their relationships, implying a certain idea of the effectiveness of thought” (RANCIÈRE, 2009a, p. 13) that is placed in styles, gestures, and ways, and is established by concepts, by rules. Rewording it, when we treat mathematics as a form or aesthetics, we realise that what forms and subjectifies us gives visibility to some instituted ways in which we learn to think and relate to things in the world.

Thus, we analyse the thinking we place on things based on what mathematical rationality establishes as a ‘standard’ or as something common that is shared, i.e., something with universal characteristics that must be shared by each and everyone, in a distribution of the possible over the configurations of what can be seen and the possible ways of talking and thinking about it (RANCIÈRE, 2009a). Thus, when we say that mathematics is seen as aesthetics, we say that it is, in some way, incorporated, and also ingrained in us, embodied as a way of thinking. An aesthetic mode that also aestheticises relationships and pushes us towards a way of inhabiting the world. There is content, matter, and language, but in turn, the content itself injects and drives thoughts, actions, ways of saying and speaking about the world, and ways of living in the world. Thus, aesthetically, mathematics also exerts relationships of knowledge and power in our formation, subjectifying and capturing us. Because “if mathematics forms us, rationalises us, gives us power and knowledge, it also tramples us, invades us, consumes us, and blinds us” (FLORES; KERSCHER; FRANCISCO, 2018, p. 140).

Hence, we dare to think of mathematics in its aesthetic facet, which can be a force that violates our thinking, that makes us think again and again, especially about things in the world. And here, not only to introduce this article but also this topic. Now, suppose there are forms and de-forms in and of the gaze, it seems to us that mathematics operates aesthetically as a discursive form and that, once placed as knowledge, it institutes the field of coordination and subordination of forms of thought. Thus, the question that remains is: Where and how do we create the habit of looking at and talking about “mathematised” things in the world, aestheticising them in a given way and not in another?

### **The case of the human body**

In biology, medicine, physical education, nutrition, psychology, sociology, and anthropology, the human body has been one of the central objects of analysis and study. In history, the body is marked by memories, a place from which facts are narrated, a plot is described and constructed. In science, its functioning and organisation become knowable. In art, whether in painting, sculpture, installations, literature, or poetry, the body is also a space for creation, invention, and intervention. And yet, in mathematics, it is often taken as a tool for contextualising content, an opening to explore concepts and find patterns.

In another moment,<sup>7</sup> we discussed the idea that body measurements are given by ideal anthropometry in these terms: by rules of *proportion*, relating the dimensions of body parts to each other and to the total height (KERSCHER; FLORES, 2020), thus presenting itself as a desire for perfection and ideal beauty. This statement about the body is delimited and reiterated, above all, by art and science because, in some way:

Science and art delineate the body in its morphological, anthropometric, and physiognomic integrity, visible through the volume of body mass, with its margins contained in the outline of the drawing; regulated in its representation by the canons of artistic morphology and in its racial, sexual, and social identity by the human sciences (FLORES, 2007, p. 51).

Let us remember the Vitruvian Man, idealised and spread in the *Dez livros de arquitetura* [The Ten Books on Architecture] by the Roman writer and architect Vitruvius (1st century BC). Some say that it is the portrait of what an ideal of beauty would be: a classic ideal of balance, harmony, symmetry, and the perfection of the proportions of the human body (KERSCHER, FLORES, 2020). Well, from what was worked on Vitruvius' text, in the updates of his writings in the Renaissance, as in Leonardo da Vinci's (1452-1519) or Albrecht Dürer's (1471-1528) works, emerged a thinking that would also be, in some way, in conformity with the body represented by the Greco-Roman art. In fact, during Renaissance, the idea of proportion was resumed, named, conceptualised, and enunciated in a discursive practice on the human body representation, but also inserted in techniques and theories about its design, and mathematics served as a support for the fabrication of its image (FLORES, 2015). It is worth remembering that, in the Renaissance, artists declined from the *status* of artisan, and painting reached the category of a liberal, intellectual, and even scientific activity (JIMENEZ, 1999).

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<sup>7</sup>Looking at the relationship between mathematics and art and the human body, we specifically mention Machado and Flores (2013), Flores (2015), and Kerschler and Flores (2020).

In the Christian tradition, the conception of a harmonious and beautiful body made as the image of God echoes, in which, in a metaphysical dimension, the proportions of the body reflect in the harmony of divine creation and the link between the microcosm and the macrocosm. Conversely, in modern art, there was a search for a representation of forms that presented the constant changes and accelerated transformations of the beginning of the 20th century. According to Michaud (2011), three major registers seem to organise the imaginary about the body in 20th-century art. First, the mechanised body, i.e., the body that, on the one hand, reflects the culture of sport and gymnastics while, on the other, is rationalised by work, typical of a mechanical human being, standardised by gestures, or of a new subject, created by science and industry. Second, the disfigured, horrified body, aestheticised by the First World War by the revolutions and civil wars that followed.

Finally, in a more contemporary way, the third register: the body of beauty, a mutant body in its forms, through aesthetic surgeries, bodybuilders, transplants and implants, through the multiplier contribution of advertising for beauty, makeup, and fashion products through social media. Indeed, in contemporary art, the representation of the body is no longer a potential for representation, but for production, for presentation, as it appears as a mechanism of social reflection, of thinking of a society as a system (MICHAUD, 2011).

The fact is that, beyond looking at the human body every day, much is said and studied about it. History, art, and science tell, narrate, and represent its traits; how it has been seen and thought. However, here we are encouraged to look at it once more, more closely or from afar, especially focusing on mathematics and art issues. We put our thoughts on the body, specifically, on its representation through art, which also talks about mathematics. We see it with a curious gaze, thinking with what we see and with what is produced about it currently.

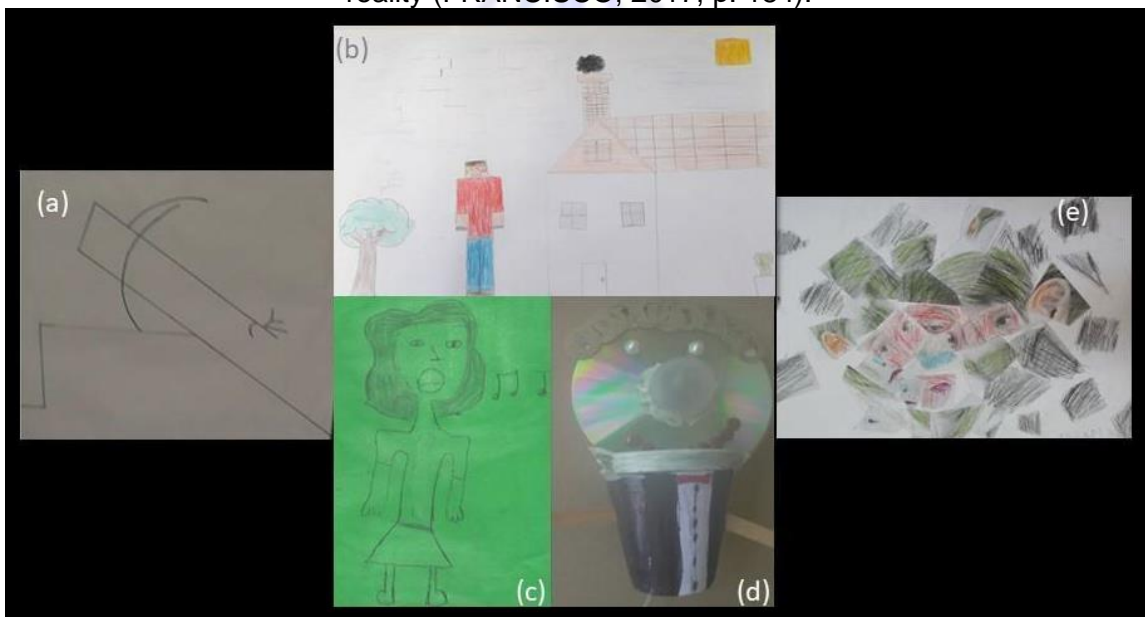
That is why we returned to studies that worked with art and mathematics, especially those developed by the study and research group GECM, to raise some traces of the existence of discourses produced about the human body and mathematics. In other words, to perceive the objective and material existence of some rules that we follow when we participate in a “discourse”, echoing, perhaps, through an aesthetics of thinking about the world and in the classroom, in which mathematical knowledge is placed as a means to talk of and about things. So, we mobilised our gaze to see and think about what echoes from the materialised visualities made possible by the encounter with art, the human body, and its representation by research that



developed workshops with elementary school 5th-graders.<sup>8</sup>Therefore, we revisit images and speeches from workshops involving mathematics and art (MORAES, 2014; FRANCISCO, 2017; KERSCHER, 2018), and we shed light on the historical and cultural limits where a given way of speaking and thinking about what is presented is already in place (FOUCAULT, 2000).

Figure 1 - Assembly: children's visualities.

In detail: (a) Body in Kandinsky (reproduction) (MORAES, 2014, p. 178); (b) The perspective in the gaze (KERSCHER, 2018, p. 158); (c) The (dis)proportion of the body I (MORAES, 2014, p. 175); (d) The (dis)proportion of the body II (MORAES, 2014, p. 186); (e) Out of reality (FRANCISCO, 2017, p. 184).



Source: GECEM image file.

I: *What do you think of the bodies Kandinsky made?*

Giovane: *They are strange. Looks like he doesn't know how to draw, it lacks width.*

Manuela: *I thought it was cool, it makes no sense to me, but to him it does...*

Iago: *For me, it's just scribbling.*

I: *Why?*

Iago: *Because it lacks form... Like this (with both hands open, Iago draws an imaginary cylinder). (MORAES, 2014, p. 182).*

Gabriel - *My God! What leg is this? The house is all crooked [laughs].*

Lucca - *Oh, my!! But is the head at the height of the sun? [laughs].*

Pedro - *I think he is pretty big.*

Gabriel - *It's supposed to be big.*

[...] Lucca - *The giant guy with a tiny head [laughs].*

<sup>8</sup>The workshops were carried out by three master's research works, in different periods, at UFSC's College of Application.

... Lucca - *Oh, my!! The size of the legs, they are huge!*

Mateus - *Look at the size of the guy, look at the size of the house.*

Pedro - *It's just that the house is further away, man.* (KERSCHER, 2018, p. 158).

I: *I want to ask you a question. Why did you use the CD to make the face?*

Sandro: *Because it's round. We didn't want to do it with a glass.*

I: *And must the head be round?*

Marcelo: *No. The head could be square, triangular, even a cube.*

I: *And couldn't the CD be the eye?*

Marcelo: *But it would be too big, it would be disproportionate. He would have to have a big body.*

Fabio: *He would have to have a bigger body than us.*

Sandro: *It could only be like this if he had a problem... If he had enormous eyes or something... A disease, we are born with... I don't know. Or someone with a super eye.*

(...)

Luiz: *Their doll's head looks like a watermelon... It's gigantic...*

I: *What do you mean?*

Luiz: *It is not good for [the doll's] body size... A very huge head...* (MORAES, 2014, p. 186-187).

With the images presented in the assemblage (Figure 1) and the children's speech, we 'put on the negotiation table' specific types of representation of the human body that inspire us to think about what this article wants to discuss. Let us see: the child who draws and produces a body outside what is usually prioritised. She or he is uncomfortable with this. They find it strange, a body made only with strokes and lines. *Where would be the 'volume' that would give life to the person? Is it actually a body?* (MORAES, 2014). The body has been transformed into something incomplete: it lacks shape, width, and contour; in short, it lacks volume (Figure 1, detail a).

Estrangement also happens due to the body's disproportion in relation to the world surrounding it. For example, the body cannot be the same height as the house in the foreground, just like the body. However, once again, to comfort the look, children point to the game around the perspective: the house was farther away than the person; one should just look at it in the correct way, and everything would be proportionally right. The children's solution was to call on mathematical concepts to solve the problem, operating with the idea of perspective and with a body that necessarily needs to be proportional to the place and position it occupies in the space. The perspective is: "a mathematical method of organising space, fulfilling the requirements of both 'correction' and 'harmony'. Therefore, it has an affinity with a

discipline that aspires to achieve the same respect for human and animal bodies: the theory of proportions” (RITTO, 2012, p. 98, emphasis added by the author). Thus, there is a desire for order, certainty, and proportion, reverberating on how to gaze correctly, or even represent, the body or else, the world around it (Figure 1, detail *b*).

Besides the strangeness of the disproportion of the body, the children said that the arm needed to be smaller than the leg and that the CD could not be the eye, as it would be too big and therefore disproportionate, almost impossible. However, they warn that *it could be like this only if it had some problem*. An ideal proportion to relate body parts to each other because the “proportion makes it beautiful... Imagine . . . Look at that huge head on a little body... Look at the size of those little legs” (MORAES, 2014, p. 175), it would be weird. And then, making the body ‘just right’ and in line with the proportion settled in thinking as a rule (Figure 1, detail *c*). By bringing the representation of the body to the three-dimensional, the idea of proportional volume is accentuated even more: the children wanted the cups because only the cup could offer support conditions for the assembly of a well-made, balanced, voluminous body. The proportion turns out to be related to the balance and functionality of the body. At the same time, the inconsistent parts mean an insufficiency or an over-functionality of the body (MORAES, 2014) (Figure 1, detail *d*).

When assembling the pieces of a self-portrait, seen from various angles, with repeated and missing pieces, using a Cubist style, the child no longer sees him/herself as a body, “his/her body was foreign to him/herself” (FRANCISCO, 2017, p. 198), while everything seemed strange and ugly, so to speak, but “to make it no longer strange, it is enough to have it just the same. To have everything very right in the body. But if you cut out the body and place the cuts one on top of the other, it’s strange” (FRANCISCO, 2017, p. 207). The strange escapes from the normality of things, from what is supposedly well done, removes order and structuring and is outside reality (Figure 1, detail *e*). In this picture, visualities pulsate from the child who wants to see what he/she was made to see: a tidy head, no missing eyes, no extra eyes, no bizarre things, weirdness. So, mathematics is called upon to intervene in a possible reality of broken bodies, which seemed to be without norms, without measuring and identification exercises, but which claimed this desire for order and clarity. When thinking about the organisation of collages with clippings of children’s photos, Francisco (2017) writes:

First, order is related to the well-seen look, to the look that makes you feel things correctly, it is harmonic, perspective, and proportional. And second, the disorder expresses a look infected by surreal, monstrous

things that bother, hurt the eye, and hurt the memory of a body that used to be better made up (FRANCISCO, 2017, p. 227).

With this, we understand that “the issue of proportions seems to have worried man from a very early age, as well as the representation of an ideal body, which we see in Egyptian art as in today’s top models” (CALADO, 2012, p. 110), or else, in the drawings and speech of children in the workshops. And this is noticeable, in fact, since “the Greek canon [which] left us as an inheritance a standard of beauty based on the principle of reason, of pleasant proportions, and harmony” (BORGES, 2015, p. 71), passing through different moments in the history of art (which is told to us and when we look through the works) until it gets at the ways of being and living in the world produced by children in the classroom. Not that this is the only way of looking at the body, a kind of fixed truth, but it is the proportional way, so to speak, that echoes and is organised at given moments, persisting and resonating until the present, capturing our gaze and impressing an aesthetic of our relating to the world.

We diagnose, therefore, some sameness in the visual. A body that is only a body when it has volume and is in a specific naturalised order, only beautiful when it is symmetrical, only functional when proportional, stereotyped within some normalcy, some rationality, in the service of a usual representation. In other words, a representation in which the prefix RE- means the conceptual form of the identical that subordinates the differences, that mediates everything, but does not mobilise or move anything (DELEUZE, 2006). Such attributes are associated with gazing, thinking and drawing, forged in a practice of representing the human body that is reiterated and repeated. Hence, mathematics also emerges in this space as an agent of modes of representation: bodies measured, proportioned, and geometrised, related to space through shapes, harmony, order, through universalisation. We rarely question where and how we created the habit of looking at the body like that or even what it is to be a body in those parameters, because this aesthetic is already imprinted in us.

We look, speak, and represent a body that is being constituted and instituted, which, through the discourses in which mathematics operates as an agent, proposes a totalised, proportional, singularised, and recognisable ‘will of form’ (TUCHERMAN, 1999). Thus, mathematics is a rational way of representing it and is characterised by how one speaks and idealises it. In other words, it is a search for perfection in which mathematics operates for the functioning of discourse, being also an agent of an aesthetics of modes of representation.



## Visualities exercised, visualisations stirred: reverberations through mathematics education

The different drawings and speeches about the human body, raised by the workshops that addressed mathematics and modern art (especially cubism, in Francisco's (2017) and abstractionism, in Moraes's (2014) and Kerscher's (2018) research), light traces to the ways of gazing and representing the human body, in addition to triggering our thinking about techniques, forms, modes, and the arts, in how mathematics is organised and organises the gaze and the thinking, an aesthetics that designates a model of thought. We want here to put ourselves in denouement, insofar as realising all this leads to the understanding that, even though the human body has gained other contours, new representations, and presentations, there is still an aesthetics thought about it linked to ideal (proportional) forms. This is because mathematics is not just a set of theorems or concepts to be learned, but it is also a set of rules that, imprinted on our thinking, make us talk about the world and the things in it.

For example, the concept of proportion we have currently in mathematics, it should be underlined, concerns the relationship of the parts of a whole with one another or the relationship between each one and the whole, the harmonious arrangement of the parts that form a whole or the harmony of the whole formed by the parts. In other words, the proportion is the ratio of equality between ratios ( $\frac{a}{b} = \frac{c}{d}$ ,  $a$  is to  $b$  what  $c$  is to  $d$ ), and, according to Roque (2012), it is very similar to the definition that expresses the idea of proportion in the Euclidean number theory. Euclid<sup>9</sup>, in definition 5 of book V of the *Elements*, about Eudoxus' theory of proportions, writes:

Magnitudes are said to be in the same ratio, a first to a second and a third to a fourth, when the same multiples of the first and the third either exceed, or at the same time are equal, or at the same time are lower than the same multiples of the second and fourth, in relation to any type of multiplication, each of each, having been taken as corresponding (ROQUE, 2012, p. 193).

In definition 6, he adds: "And the magnitudes, having the same ratio, be said in proportion" (ROQUE, 2012, p. 193). This notion of proportion took certain forms, being constituted as a basis for the rational principles of building the human figure, in which, for example, the dimension of the head is related to the dimensions of body parts and the total height, or even the dimensions of body parts with one another, as mentioned

<sup>9</sup>It is said that Euclid lived in the 3rd century BC. He is the author of *Elements*, a set of thirteen books in which results of different types are exposed, mainly on geometry, but also on arithmetic.

earlier. However, even more specifically, it says there are relations between the human body and what has been called the<sup>10</sup> golden ratio, golden equation, golden section, divine proportion, or golden number,<sup>11</sup> i.e., ratios that result in an irrational algebraic real constant (which can also be given by the numerical expression:  $\left(\frac{1+\sqrt{5}}{2}\right)$ ), later represented by the Greek letter  $\varphi$  (*phi*), and that geometrically can be represented by dividing a line into two segments ( $a$  and  $b$ , segment  $a$  being longer than the segment  $b$ ), when the sum of these segments ( $a + b$ ) is divided by the longest part ( $a$ ) the result obtained is  $\varphi \cong 1,618033 \dots$ , which is also equal to the longest segment ( $a$ ) of the line divided by the smaller segment ( $b$ )<sup>12</sup>.

From what we see, something there insists on its permanence. Note, for example, the expressiveness that still occurs today regarding the idea of proportion of the human body (Figure 2). We found in the 7th-grade textbook, *Teláris matemática: ensino fundamental, anos finais* [*Teláris mathematics: elementary school, final years*], by Luiz Roberto Dante, at the end of the chapter on proportionality, a text as suggested reading on “a proporçãonaarte – Antiguidade e Renascimento” [“proportion in art – Antiquity and Renaissance”] (DANTE, 2018, p. 216). Another textbook that discusses proportion relationships in the human body is *Matemática: compreensão e prática* [*Mathematics: understanding and practice*], aimed at the 7th grade, by Ênio Silveira. After presenting the concept of proportion, the author exposes some proportion relations of the human body from the work *Vitruvian Man*, by Leonardo da Vinci (SILVEIRA, 2018, p. 186). Therefore, the representation of the body is used as a tool for the contextualisation of contents or an opening to explore concepts to find some patterns. There is also mathematics operating in the agency of ways of looking and that speaks of looking at the body, an aesthetics of thought, reinforcing some sameness of the visual.

Figure 2 - Assemblage: Human body and textbook.  
In detail: (a) Dante (2018, p. 216); (b) Silveira (2018, p. 186).

<sup>10</sup>As an example: the height divided by the length from the navel to the floor; the size of the entire arm divided by the length between the elbow and the finger; the length of the entire leg divided by the length from the knee to the floor; the height of the skull divided by the size of the jaw, etc.

<sup>11</sup>This relationship is also shown in Book VI of the *Elements* of Euclid, with the name of mean and extreme ratio, whose definition 3 says that “A line segment is divided into mean and extreme ratio if the ratio of the whole to the largest segment is equal to the ratio of the largest to the smallest segment”.

<sup>12</sup> Hence the equation:  $ab=(a+b)a=.$





of some visualities, we move the understanding and questioning of assumed truths, imposed consensus, the nature of naturalities. We create fissures in thought by twisting it. We provoke thinking about what constitutes us, a way of existing again, a philosophical and critical stance of what we are, a work that is always to be done in the face of an attitude, a new *ethos* (FOUCAULT, 2000). Because not putting thought into operation is accepting how things are presented to us, accepting to be submitted to imposed orders, idealisations, delimited aesthetics, controls, and subjectivations produced, without, at least, thinking about them and with them.

By knowing our historical limits, we emphasise that we can make our choices and produce paths towards what we want to remain or change. And that we fight for this, opening ourselves to new possibilities; that we fight for ethics, politics, and aesthetics of existence, which reverberates through mathematics education, and, who knows, through teachers and through the classroom.

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