How to decolonize a discipline: the example of mathematics[1]

Introduction

Grand theories come and go. They only stick around when they have practical policy implications. Decolonial theory has been around for a few decades. It has made an important contribution to the critique of Eurocentric knowledge production, and especially in the field of epistemology. But it lacks the practical policy implications on how to change society. If we are unable to lay down the practical implication of decolonial theory, then it might meet the same fate as other grand theories such as postcolonialism.
In this contribution I attempt to provide a model for decolonizing knowledge in such a way that it becomes a tool to develop policies in different areas of society. The model is presented in my book *Decolonizing The Mind - A Guide to Decolonial Theory and Practice*.[2]
In order to develop a trajectory for decolonizing knowledge, we need to have a clear understanding of how knowledge was colonized in general and how it took place on the level of disciplines. From there we can set out a trajectory to decolonize a discipline.

How knowledge was colonized in general

What is knowledge?

I define knowledge in general as *"the collection of insights and understanding about the natural and social world."* All societies have systems to produce knowledge. A collection of societies might have a common knowledge base. They form a civilization.
There are two dimensions of knowledge. The first is about understanding the world. The results are statements that are captured along the line of true and false. This is the scientific dimension of knowledge. The second is about how to behave and interact with the world. The results are statements that are captured along the line of right and wrong. This is the ethical dimension of knowledge.
In many civilizations these two dimensions were connected to each other. The sources for understand the world are observation, reasoning, innate knowledge, social interaction, creativity, imagination and common sense. The sources for behaviour and interaction with the world are spirituality, revelation and tradition.
The centres for the production of knowledge in pre-colonial civilizations often combined these dimensions. Science and ethics were taught in temples and spiritual centres.
A discipline is a branch of knowledge that deals with a specific part of the natural and social world. A discipline also has the two dimensions of knowledge: science and ethics.
On the basis of knowledge production societies establish and maintain institutions: economic, political, social, cultural and technological institutions. They build cities with complex architecture that require deep knowledge of the natural and social world.

The knowledge bases of colonialism

Global colonialism started in 1492 with the Spanish occupation of Abya Yala (formerly known as the Americas). In the first 150 years the knowledge base of colonialism was Christian theology. After 1650 the European Enlightenment replaced Christian theology as the knowledge base of colonialism. Here are its main characteristics.

First, the European Enlightenment arose from a fierce political and intellectual struggle with Christian theology and the Church. The political struggle led to the separation of state and church. The intellectual struggle led to the separation of ethics from knowledge, so that knowledge became only science. This separation took place in the field of epistemology in six stages and with six propositions.

The first proposition that the Bible is not the only source of knowledge. In fact, the Bible was disregarded as a valid source of knowledge in general. René Descartes (1596-1650) argued that the mind can create valid knowledge independent of the bible.
The second proposition is that knowledge is derived from experience and not from religious texts (John Locke (1632-1704)).
The third proposition is that something more is needed than observation and reasoning to produce new knowledge: analysis and theory (Immanuel Kant (1724-1804)).
The fourth proposition is that theoretical analysis needed to be validated. It should be able to predict the outcome of experience (George Hegel (1770-1831)).
The fifth proposition is that valid knowledge is secular. With positivism the actual separation of religion from science takes place and science becomes secular (August Comte (1798-1857)).
The last proposition is that positivism applies both to social and natural sciences. The same methodology is use for the production of valid knowledge.

The second characteristic of the European Enlightenment is the introduction racism in knowledge production. I define racism as *"a global system of economic, political, social and cultural institutions that organize the relationship between human beings on the basis of superiority and inferiority."* The defining characteristic is not biological race and not even ethnicity, but the organization of relationships between human beings on the basis of superiority and inferiority. The principle of this organization can be race or ethnic group, but colonialism started with religion as the organizing principle. Although the term racism contains "race" as the core concept, the system should not be limited to race. It is about superiority/inferiority that is linked to race, but not limited to race.
With colonialism, racism became a worldwide phenomenon and was institutionalized in economics, political structures, social relations and cultural institutions on a global scale. While other systems of oppression, exploitation and dehumanization were regional or local, Western colonialism brought this to a global scale. This means that even in countries where there are no or hardly any people of colour - like Japan - ideas about inferiority of people of colour can still exist because of the global impact of colonialism.
With colonialism racism became an integral part of knowledge production. The concept of superiority/inferiority was and is used to justify the colonial world system. It also created and institutionalized the mechanisms of the colonization of the mind.
Three concepts of racism have been developed in colonialism. They are linked to the authority of knowledge production.

- Theological racism: the concept of superiority/inferiority is argued from theology and is linked to theologians as the authority of knowledge production.
- Biological racism: the concept of superiority/inferiority is argued from philosophy and the natural sciences and is linked to philosophers and natural scientists as the authority of knowledge production. This coincides with the rise of the trans-Atlantic slave trade.
- Cultural racism: the concept of superiority/inferiority is argued from the social sciences and is linked to social scientists as the authority of knowledge production.

Racism was embedded in the different disciplines of knowledge production of the European Enlightenment.

The third characteristic of the European Enlightenment is the claim of universality. Colonialism with its political power transformed the local indigenous knowledge of Europe into universal knowledge. European economic theory has become universal economic theory, both in the Liberal and Marxist tradition. All the disciplines of science have now the status of universal knowledge.

The fourth characteristic is of the European Enlightenment is the racist claim of uniqueness. In the White Enlightenment Europe is the centre of world history. Europe is unique and exceptional in world history. Here is where humankind achieved its peak. Here is where scientific knowledge arose. No other place on the globe and at no point in history did humankind use reason to create the best possible society. Rationalism arose in Europe. Here is where people first started to think with their mind and not with other

parts of their body as is the case in non-Western civilizations. Europe is not just a geographical location. It is a point of racial identification for white people whether they live in Europe, the United States, Australia or South Africa. Scientific knowledge was produced by a white civilization. Other civilizations did not know scientific knowledge. The Enlightenment is called the Age of Reason, because only then did humans produce scientific knowledge based on observation and reason. Europe is exceptional. Non-White civilizations did not use reason but based their knowledge on backward superstition. Not only was Europe unique, but its white race was unique and superior to other races (see chapter six on racism and knowledge production for a full exposé of this question).

Decolonizing the discipline of mathematics

Defining the discipline

The first problem in decolonizing a discipline is the problem of definition. Take the example of economics. A standard liberal textbook by Samuelson and Nordhaus defines economics as *"the study of how societies use scarce resources to produce valuable goods and services and distribute them among different individuals. If we think about the definitions, we find two key ideas that run through all of economics: that goods are scarce and that society must use its resources efficiently."*[3] This is local indigenous knowledge of Europe that was made universal, so this definition claims universal validity. In Islamic civilization economics is not defined in terms of efficient allocation of scarce resources, but in terms of social justice: the allocation of resources in a just manner. This gives rise to very different economic theories.

Decolonization of a discipline start with question the nature and definition of the discipline as it is articulated in Eurocentric knowledge production. Morris Kline gives a simple definition of mathematics: *"It is a study of space and quantity."*[4] Mathematics directly supplies information about these aspects of the physical world. He continues: *"Historically, intellectually, and practically, mathematics is primarily man's finest creation for the investigation of nature. The major concepts, broad methods, and even specific theorems have been derived from the study of nature; and mathematics is valuable largely because of its contributions to the understanding and mastery of the physical world."*[5]

Kline goes on to explain that mathematics became a tool for natural sciences to draw the implications of their observations. It organizes the observations of natural phenomena in coherent, deductive patterns. The natural sciences has reached a state in which their theories are entirely mathematical whereas the physical meanings are vague, incomplete, and in some instances even self-contradictory. Science has become a collection of mathematical theories adorned with a few physical facts. The goal of modern scientific theory it is to subsume all its results under one mathematical principle whose implications would describe the multifarious operations of nature.

This sounds like an adequate definition and description that resonates with the history of mathematics. There is a clear link between the object of study of a discipline and the empirical reality. In Eurocentric knowledge production there has been a development where the link between ideas and empirical reality is lost and fantasies replace science. It is evident in the social sciences where fantasies replace facts in knowledge production. I will discuss this later under the heading of conceptual thinking. But is also present in mathematics.

In the writings of mathematicians like Bertrand Russell we encounter a different definition. He says: *"Mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we are saying is true."*[6] He makes a difference between pure mathematics and applied mathematics. Russell: *"Pure mathematics consists entirely of assertions to the effect that, if such and such a proposition is true of anything, then such and such another proposition is true of that thing. It is essential not to discuss whether the first proposition is really true, and not to mention what the anything is, of which it is supposed to be true. Both these points would belong to applied mathematics."*[7]

Once you detach mathematics from its empirical reality, you can easily end up with fantasies, that contradicts reality. One example is the Ramanujan series, developed by Shrinavasa Ramanujan (1887-1920), that calculates the sum of all natural numbers: 1+2+3+4+5+⋯=− 1/12. So if you receive 1 dollar incrementally till infinity, you don't become extremely rich, but you end up in debt. In pure mathematics this is possible. In the real world this is nonsense.
The distinction between pure mathematics and applied mathematics did not exist in other civilizations. It became prominent in Euromathematics. It opened the door to producing fantasies in stead of scientific knowledge.
An important part of decolonizing mathematics is a fundament critique of pure mathematics and how it produces fantasies. It is present in set theory.

The general features of the colonization of mathematics

The four characteristics of Eurocentric knowledge in general can be found in the distinctive disciplines. When we want to decolonize a specific disciplines, we will look at how these general characteristics are expressed in the discipline. The characteristics are:
1. The separation of ethics from knowledge and the secularization of science.
2. The introduction of racism in knowledge production.
3. The claim of universalism.
4. The claim of uniqueness of Western knowledge.

How are these features expressed in the discipline of mathematics? The field in which this is very clear is in the historiography of mathematics. Thomas Crump compares non-Western with Western mathematics and concludes that *"European mathematics is mathematics; all other mathematics is anthropology. That explains why this other mathematics belongs to what has been called ethnoscience'."*[8]
In other words, European mathematics is superior to non-Western mathematics. By characterizing non-Western mathematics as anthropology Crump asserts that non-Europeans have not made any significant contribution to mathematics. Their work maybe of relevance for anthropologists who study non-Western cultures. Mathematicians have nothing to gain from these studies. How is the argument for the superiority of Euromathematics constructed through historiography?
It puts the focus of the start of the history of mathematics on the Greeks. The Greeks invented mathematics, so the story is being told from that perspective. Many textbooks devote a major part of the initial history of mathematics to the Greeks. Then history stops and skips thousands of years to be renovated and continued with the European Renaissance (14th till 17th century) and Enlightenment (17th century and onwards).
The next step is the argument that logical reasoning and proof was the exclusive invention of the Greeks. The idea that knowledge production through logical reasoning and proof is a typical Western invention is a racist idea. It presupposes that people of colour have a different mindset that is not capable of thinking logically. The whole idea of non-Western mathematics as an intuitive and irrational science that is based on stumbling with empirical data goes against common sense. Why? Because mathematics is not just about calculations. It is about engineering. How is it possible to conduct elaborate and complex engineering without understanding the analysis and concepts behind its mathematics? The Great Pyramid at Giza, erected about 2600 B.C. by Khufu, was called Cheops by the Greek. According to the Greek historian Herodotus (484-425 BCE), who visited the pyramid and talked to the priests - the scientists of those times who knew about the architecture and its history - it took 30 years and 400,000 workmen to build the pyramid. For ten years a road was constructed to a limestone quarry some miles distant from Giza. Some 2,300,000 blocks of stone averaging 2.5 tons each and measuring 3 feet in each direction were transported over this road. These blocks were fitted together so perfectly that a knife blade could not be inserted in the joints. The pyramid is 481.2 feet (146.7 meters) high. The base occupied 13 acres (52,609 m2), which is the combined areas of the cathedrals of Florence and Milan, St. Peter's in Rome, and St. Paul's Cathedral and Westminster Abbey in London. The base was almost a perfect square. By using one of the celestial bodies, the Giza builders were able to orient

the sides of the pyramid almost exactly with the four cardinal points of the compass, the error being only fractions of 1◦.454 How is this type of engineering possible if you don't understand what you are doing? This was not a job of one engineer working over a short period. It involved not only 400,000 labourers but possible thousands of engineers who had to be trained over a long period of time both for the construction and the organization of the construction. How was this training done if the teachers didn't understand what they were doing? Common sense tells us that they must have known what they are doing, that they must have had analytical skills and theoretical concepts that enabled them to make the plans and then perform the necessary calculations before any construction was done. The construction was not a matter of trial and error. It must have been based on an architectural plan that must have involved complex mathematics.
The Greeks developed a mathematical method based on logical reasoning and proof that became the basis of Euromathematics. Why is it impossible that non-Greek mathematicians also used logical reasoning and proof? The fact that no written records have survived to testify to it, does not mean that they did not use these methods. It's like saying that if something is not reported in a newspaper, it did not happen.
The claim of the superiority of Euromathematics is also expressed in the naming of mathematical achievements in the historiography of mathematics. If the so-called Pythagorean theorem was not first invented by Pythagoras but by the Africans in Egypt, why don't we call it the African theorem of the right-angle triangle? Why should we award the first prize for a marathon to the person who came in second or third? The naming of the theorem attributes to the Greeks the first invention of something that was invented elsewhere at a much earlier date. And thus, it eliminates the contributions of non-Western civilizations and creates the idea of an exclusive Greek contribution to science.
Another example of curious naming is the so-called Rhind Papyrus. The papyrus was written by a scribe named Ahmes in ancient Egypt in around 1650 BCE. It is an important and precious source of Egyptian mathematics. A scribe is a person who did the writing on the papyrus roles. Alexander Henry Rhind was a Scottish antiquarian, who purchased the papyrus in 1858 in Luxor, Egypt. It was stolen during illegal excavations near the memorial temple of Pharaoh Ramesses II and bought by Rhind. Common sense tells you that a document should be named after the author and not after the second or third buyer. In the Eurocentric historiography the papers are named the Rhind Papers, after the European who bought the stolen papers rather than after the author, Ahmes. The reason is to sustain the claim of extraordinary achievement, the so-called discovery of the Egyptian mathematical papyrus.
A major DTM critique of the Western historiography of mathematics is the lack of acknowledgement that the Greek mathematicians are indebted to Africans for their knowledge. It goes against the racist idea of the inferiority of Africa. There is some mention that Greeks are to a certain degree indebted to Egyptians without specifying the nature of that debt. Furthermore, often, ancient Egypt is not seen as part of Africa but situated in the "Near East". The ancient Greeks themselves were very specific about their relationship with the Egyptians. They saw them as their teachers. The Egyptian civilization was a highly developed civilization that was admired and respected by the Greeks. Their educational institutes were the Egyptian temples. Their scientists were the priests of these temples. The temples had libraries where students could access the knowledge of that time. So it is not surprising that Greek students were anxious to study in Egypt at these institutes. Historians from the antiquity documented the relationship between Greek students and their African teachers.[9]
The description provided above disproves the claims of universality and uniqueness of Euromathematics. It also show how racism was embedded in Euromathematics. Now let's take a closer look at the separation of ethics from knowledge and the secularization of science in mathematics.
In many non-Western cultures mathematics has been deeply interwoven with cultural and spiritual life. Safura Meeran a.o. studied the use of the Morabaraba board game, dating back to around 1440 BCE, to explain African mathematical concepts in the class room. They concluded that the "Morabaraba game allowed for the emergence of

mathematical knowledge, created the identification of specific mathematical concepts, permitted conducive integration of Morabaraba into CAPS-related mathematical knowledge in the Intermediate Phase and showed that teachers are innovative and creative in incorporating Indigenous knowledge systems into the formal curriculum by adapting the rules of the games."

Mathematics is used in diverse religious contexts, ranging from complex calendar calculations to intricate sacred geometries. The Ethiopian people officially celebrate five major religious holidays every year: the New Year, Holy Cross, Christmas, Epiphany and Easter. They use the calendar of the Ethiopian Orthodox Twahedo Church (EOTC). The dates of some of the fasting periods and the religious holidays also vary from year to year. S. Tafesse shows how EOTC applies number theory to calculate moveable feasts and fasting periods.[10]

This shows that there an ethical dimension to the use of mathematical knowledge. Its use in religion is not just technical but an integral part of religious ethics. Knowledge is not neutral of objective. Knowledge is used to build the tool to oppress and kill people. Take an average textbook on physics in general and nuclear physics in particular and you will not find a chapter on the ethics of scientific research, a chapter that might set the boundaries and direction of the research and its methodology. Nowadays fundamental research in the natural sciences is hardly possible without a large infrastructure. The question is who is funding and directing the research? And obviously this is either a government or big private companies. In the case of nuclear physics government policy directs scientists to developing nuclear bombs. The first atomic bomb was developed in the USA. The decision to develop the bomb was made in 1939, before the start of World War II. On July 16, 1945, the first successful test taken place. Three months earlier, the selection of targets to be bombed in Japan had taken place. On August 6th and August 9th Hiroshima and Nagasaki were bombed with 129,000 and 226,000 people, mostly civilians, killed in each city respectively. One scholar concludes after a thorough investigation: *"The use of the atomic bomb, most experts now believe, was totally unnecessary. Even people who support the decision for various reasons acknowledge that almost certainly the Japanese would have surrendered before the initial invasion planned for November. The U.S. Strategic Bombing Survey stated that officially in 1946."*[11] Can we hold not only the politicians, but also the scientists accountable for these unnecessary killings? Should questions like these be part of textbooks on physics? Are they part of the ethics of the research methodology (what research questions should we ask or specifically ignore)? Is it possible for a government or leaders of a country to prohibit certain forms of scientific research by not funding research that is morally unacceptable? Including these topics in a textbook has to do with how we regard a scientist: as a human being responsible for how to use his or her talents for the benefit of society or as instruments to gather knowledge and produce whatever the funder of the research wants? From the Eurocentric epistemological principle of the separation of object and subject the answer is: the scientist gathers knowledge without the impediment of moral considerations. From a decolonial epistemology the object and subject are related and thus the scientist should make explicit his or her moral principles in setting up the content and methodology of their research projects.

The specific features of the colonization of mathematics

A critique of pure mathematics as invalid knowledge

Apart from the general characteristics of the colonization of knowledge that apply to the different disciplines, there are also specific features in the colonization of a specific discipline. The first one is reflected in the definition of mathematics.

I mentioned above that the distinction between pure mathematics and applied mathematics did not exist in other civilizations. Pure mathematics is the study of mathematical concepts independently of any application outside of mathematics. It's math done for its own sake, driven by curiosity, logic, and the search for abstract patterns and structures. The notion that there is a valid mathematical system that is detached from reality opens the door for presenting fantasies as valid knowledge. I mentioned the Ramanujan series as an example of invalid mathematical knowledge. In

decolonizing pure mathematics we try to figure out what is valid and invalid in their claims of producing scientific knowledge. On the theoretical level this means taking a critical look at the branches that uses pure mathematics such as string theory and set theory.

The misuse of mathematics in nature

The idea that nature is organized along mathematical rules is pervasive in Western science. If you understand the mathematical laws of nature, you can predict how nature will react in certain circumstances. In this view mathematics expresses the ultimate truth about nature. Western science is based on the idea of natural laws. *"Natural laws,"* says V. Tabak, *"are important to science because natural laws are used. They are used to generate new scientific discoveries and to clarify old ones. Natural laws, mathematically expressed, form the basis of a great deal of scientific research."*[12] But not all of nature operates according to mathematical laws. In fact, most processes in nature (living and nonliving) don't operate according to mathematical laws. If you only used mathematical rules to understand nature, you might easily go wrong. Decolonizing mathematics investigates these cases to show the limitations of Euromathematics.

Look at the following example: 2-1=1. Take two objects and remove one: the end result is one object. In Western knowledge production this is an absolute truth. In decolonial knowledge production the result does not depend on a mathematical formula, but on actual, real conditions. Under certain circumstances you might get another result, for example: 2-1=0. Take the example of two birds in a tree. A hunter shoots one bird that falls dead on the ground. How many birds will be left in the tree? If you use the mathematical formula, you would say that one bird is left. In practice, an outcome might be that there are no birds left, because the second bird might have flown away out of fear. The mathematical formula cannot predict this outcome, because mathematics presumes independence of the actual conditions in reality. If you understand nature in a decolonial way, you understand the limitations of mathematics. Second, Euromathematics is based on two-value logic: true or false. The two-value logic leads to a limited understanding of the world. In the real world something can be both true and false. Nature is not based on two-value logic. There is evolution, growth, decline, change, ruptures. How is the evolution from fish to human beings captured in mathematics? It cannot be done. Taking mathematics as the key to understanding nature limits our understanding of nature.

Third, by invoking mathematics as the language of nature, the research into what nature is and how it works misses a crucial element: consciousness. In the Eurocentric view nature is only conceptualized as matter: a physical substance that has length, breadth, height, and occupies a particular position in space. How do you deal with something that clearly exists, but is not a substance in space: consciousness? If you have a mathematical view of nature, the research into consciousness is limited to how the brain functions. You cannot imagine research that looks into how something can exist that is nonphysical. That is relegated to religion, and is not part of science. But consciousness – what it is, how it works – should be studied from all perspectives, and should not be restricted to one that limits its character to the relationship with physical substances.

Fourth, if you view nature as a kind of machine that operates with mathematical rules you disguise the ethical basis of mathematics. And that can lead to disasters in dealing with nature. Ethics involves the relationship between human beings and nature. In non-Western knowledge systems respect for nature was the basis for this relationship. Respect was good. Disrespect was bad. The ethics could be founded in religion, spirituality or a way of life. A mechanical view of nature (through mathematics) takes these ethics out of the system of knowledge and supplants it with other ethics that basically disrespect nature, but hides the disrespect under the banner of objectivity. In a capitalist system that uses a mechanical view of nature, this leads to the idea that nature can and should be manipulated and controlled for profit. The enormous problems of environment and the disequilibrium of eco-systems are the product of this view of nature. Euromathematics laid the basis for this view.

In Western science mathematics is presented as a key to understanding nature. In DTM it is other way around. Nature shows us the limitations of mathematics in understanding reality.

The misuse of mathematics in social sciences

On a more practical level mathematics is used in social sciences to create the illusion of scientific knowledge. That is the first critique of the use of mathematics in social sciences. The role of mathematics in the progress of technology with the natural sciences led to the idea that mathematics is the symbol of the ultimate truth. If a proposition can be backed up with mathematical proof, then it certainly is true and right.
The methodology of social science was modeled on the natural sciences: observation (data collection) and reasoning (induction, deduction, validation). This does not necessarily lead to a better understanding of social reality, and it can even produce lies. Western science claims that the natural sciences have discovered the "laws of nature" through mathematics. In a similar way social sciences claim that they are in the business of discovering social laws that govern society. In natural sciences, mathematics plays the role of the carrier of the ultimate truth. The knowledge about nature is objective and mathematics shows this objectivity in the most excellent form; the laws are independent of the actions of and will of human beings.
Mathematical models are built to simulate social processes. It creates the illusion of objectivity, because it hides ethics behind mathematical formulas. That is the first decolonial critique of the use of mathematics in social sciences. Take the example of the law of supply and demand in economic theory.
This law stipulates that when the demand for a good of service grows the price will increase and vice versa and when the supply of that good or service increases, the price will decline, and vice versa. It operates as an objective law in human societies where markets govern economic production and distribution of goods and services. Adam Smith (1723-1790), a Scottish founder of Eurocentric economic theory, explains the reason behind this. The market operates as an invisible hand in situation in which each party in the market tries to gain maximum profit. In pursuing their individual gain without the intention to benefit society as a whole, they contribute to a more efficient production and distribution of goods and services and thus contribute to the welfare of society as a whole, even if this was not their intention. Although a person *"intends only his own gain; and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention,"* says Smith.[13] Muhammad Baqir as-Sadr (1935-1980), a Muslim scholar from Iraq who wrote an interesting critique of Western economics, explains the difference between the laws of nature and the laws of economics: *"The law of supply and demand… is not an objective law operating independently of understanding, of man, as do the laws of physics and astronomy."* This so-called law depends *"on the correctness of the values and ideas whereupon it was based."*[14] The law is not a matter of true or false (knowledge), but of right or wrong (ethics). If the demand for bread is high, then the rise in prices is not because of a law, but because of ethics, a value called greed.
The second critique of the use of mathematics in social sciences is how it produces blatant lies to justify colonialism or paint a morally acceptable version of crimes against humanity. I will illustrate this with the example of the use of mathematics, specifically statistics, to describe the horrible system of the European enslavement of Africans. A general trend among many white historians of enslavement (and their black followers who they have trained) is the use of statistics to show that enslavement was not as bad a system as blacks might think. Holland was one of the major culprits of the European enslavement of Africans. P.C. Emmer, a leading white historian in Dutch colonial history, discusses the morality of the Dutch regarding the European enslavement: *"How guilty is Holland? Sometimes it is quite easy to just be a small country. Whatever you do, it cannot be that bad, that much and that horrible compared to bigger countries. Does that hold for the Dutch slave trade? After all, the share of the Netherlands in the trade was not more than 5 percent. That means that 95% of all slaves from Africa to America was not brought by Dutch ships. England, Portugal and France have transported much more slaves."*[15] Statistics are used as an indicator of morality. The Dutch don't have to feel

guilty about their role in the hideous crime of enslavement, because it was not big. But there is no relationship at all between morality and statistics. You don't have a higher sense of morality if you have enslaved less people. Morality is about whether to get involved in a crime at all, not the extent to which you commit that.
Besides, the reason for the lower percentage for the Dutch is not that they did not want more slaves. Brazil was the colony with the largest number of enslaved Africans. Initially it was colonized by the Dutch, but they were kicked out by their rival, Portugal. If the Dutch had managed to keep Brazil, they would have become the major receiver of Africans via the transatlantic trade. The reason they had a smaller share was not because they did not want a higher share. It was because they could not get it. What kind of morality is that?
This type of reasoning is used in a lot of Western literature on black enslavement. A classical study of white scholars who use mathematics to show that the system of black enslavement was not as bad as many people think, is a study by R. Fogel and S. Engerman titled *Time on the Cross*. In fact, one proposition of their study is to show that *"the material (not psychological) conditions of the lives of slaves compared favourably with those of free industrial workers."*[16] Enslavement was better for the enslaved compared to capitalism for the free industrial workers!
Their technique is very simplistic. They conceptualize enslavement as a collection of indicators (variables) about the material condition of black people. Then they select the data for the indicators that fits in their storyline that slavery was not as bad as people think. Finally, they provide an analytical framework for the storyline with the indicators to "prove" their propositions.
I will illustrate their technique with their analysis of whipping during enslavement. They select data to show that whipping did not occur frequently: *"The only systematic record of whipping now available from an extended period comes from the diary of Bennet Barrow, a Louisiana planter who believed that to spare the rod was to spoil the slave. His plantation numbered 200 slaves, of whom 120 were in the labor force. The records show that over the course of two years a total of 160 whippings were administered, an average of 0,7 whipping per hand per year. About half of the hands were not whipped at all during the period."*[17]
Enslavement in the USA lasted from around 1620 to 1865. Some 400,000 Africans were kidnapped and brought to the USA in that period. At the time of the legal abolition of enslavement in 1865 there were around four million enslaved Africans and 250.000 who were already free during slavery. In the space of 250 years, tens of millions more were born free and enslaved after birth. Even with the most superficial knowledge of statistics one would not dare to use the numbers registered by one enslaver during two years and 200 enslaved Africans to draw general conclusions about whipping during 250 years of enslavement involving tens of millions of enslaved people. Yet this is what Fogel and Engerman have done.
The US is a country where – compared to the Caribbean - there is extensive documentation of how enslaved Africans experienced enslavement. Austin Steward was an enslaved African and escaped to freedom in 1813. He wrote his memoirs in which he mentions whipping on a regular basis: *"The overseer always went around with a whip, about nine feet long, made of the toughest kind of cowhide, the but-end of which was loaded with lead, and was about four or five inches in circumference, running to a point at the opposite extremity. This made a dreadful instrument of torture, and, when in the hands of a cruel overseer, it was truly fearful. With it, the skin of an ox or a horse could be cut through. Hence, it was no uncommon thing to see the poor slaves with their backs mangled in a most horrible manner. Our overseer, thus armed with his cowhide, and with a large bull-dog behind him, followed the slaves all day; and, if one of them fell in the rear from any cause, this cruel weapon was plied with terrible force."*[18]
This is a totally different picture provided by a victim who was enslaved for twenty years before escaping to freedom. It is not only about frequency (every day), but also about the impact of whipping, which the statistics of Fogel and Engerman do not show. The data of Fogel and Engerman are scanty and very selective. They don't take other data

such as Steward's biography into account. Furthermore, the variable they use for whipping gives an erroneous view of the practice of whipping.
What is the practice of whipping? Apparently Fogel and Engerman have in mind the end result of the practice: the actual physical contact of the whip and the skin of a person. So if you collect statistics on whipping, then you collect data on the physical contact and look for material such as the one that was collected by Barrow. Steward shows that the practice of whipping is a process, not an incident. The crucial variable that characterizes this process is not the actual physical contact, but the threat of using the whip. What variable expresses this threat? The duration of the time during which a whipping could be started? That could happen to any enslaved person during any time of the day, every day of the week. It was inherent to the system! So there was always the possibility that an enslaved person could get whipped if he didn't follow the instructions of the enslaver. Already, in the process of collecting statistical data on the nature of whipping during slavery, Fogel and Engerman manipulate the outcome by selecting a variable to create a favourable impression of enslavement.
The processing of the data is also carried out with the same aim. They calculate the average whipping per hand per year. The calculation is as follows: 160 whippings in two years is 80 whippings per year. For an enslaved population of 200 at Barrow's plantation, of which 160 are laborers, this is 0.7 whippings per laborer. Fogel and Engerman conclude: *"About half of the hands were not whipped at all during the period."* (160-80=80).
The calculation creates the impression that whipping was infrequent. But there is another calculation possible that leads to the opposite conclusion. With 80 whippings per year the average whippings per week was 80/52=1.5! So every week 1-2 persons got whipped and all the others could have witnessed the whipping.
Fogel and Engerman provide an analytical framework for a storyline that whipping was not as bad as one might think: "There was nothing exceptional about the use of whipping, to enforce discipline among slaves until the beginning of the nineteenth century. It must be remembered that through the centuries whipping was considered a fully acceptable form of punishment, not merely for criminals but also for honest men or women who in some way shirked their duties. Whipping for wives, for example, was even sanctified in some version of the Scripture."475 Whipping is not a big deal. It happens everywhere; even the Bible sanctions it. What can a scientist do in such cases?
They use a common technique in Eurocentric science regarding colonial crimes: use a generic label for systems that are very different so the difference between a horrible crime and a light offense is washed away.
When one thinks of a husband beating his wife in a marriage the beating is not inherent to the system of marriage. Not every marriage is bound to be characterized by beating. In a system of slavery whipping is inherent to the maintenance of the system. Terrorism is crucial to maintaining a system where human beings are forced to work for free and are sold like cattle. And beating is not done with a slap of the hand, but with a tool of torture.
Steward describes a whipping in a story about his sister: *"One pleasant Sabbath morning, as I was passing the house where she lived, on my way to the Presbyterian church, where I was sent to ring the bell as usual, I heard the most piteous cries and earnest pleadings issuing from the dwelling. To my horror and the astonishment of those with me, my poor sister made her appearance, weeping bitterly, and followed by her inhuman master, who was polluting the air of that clear Sabbath morning, with the most horrid imprecations and threatenings, and at the same time flourishing a large rawhide. Very soon his bottled wrath burst forth, and the blows, aimed with all his strength, descended upon the unprotected head, shoulders and back of the helpless woman, until she was literally cut to pieces. She writhed in his powerful grasp, while shriek after shriek cried away in heart-rending moanings; and yet the inhuman demon continued to beat her, though her pleading cries had ceased, until obliged to desist from the exhaustion of his own strength."*[19]

Mathematics enables Fogel and Engerman to eradicate the difference between whipping in a system of marriage and whipping in slavery. It is just about comparing the frequency of the physical contact between the person who gets whipped and the whip.
Fogel and Engerman are part of a tradition that created a branch in economic history called cliometrics, the use of mathematics in history. Their book was very influential and received the prestigious Bancroft Prize of Columbia University for books about the history of the Americas. Fogel even won the Nobel prize for economics. But if we peel off the appearance of objectivity that mathematics provides, the end result is an ideological construction to present a crime against humanity as a legitimate social system. This is not science. This is an exercise in how to lie with statistics.
There are similar developments in other branches of social sciences such as sociometry and pyschometry.

The colonization of the education in mathematics

Mathematics is an indispensable part of formal education on different level, including primary school. In the education of math the colonial historiography is still dominant. My analysis above of how the historiography has been colonized provides the elements of the colonization of math.
Another aspect of how mathematics has been colonized in education is the neglect of interesting contributions in the education of math that is developed outside the West. Finger mathematics is the use of one's fingers as a physical tool to perform mathematical operations. It encompasses a wide range of practices, from a child's basic counting to complex, formalized systems for arithmetic calculation. It is embedded in the educational system of South Korea. In China and Japan they use lines to perform multiplication (stick multiplication, Chinese or Japanese multiplication). This method is visual and more attractive for young kids who are visually oriented in learning mathematics. Yet these methods are not considered for use in Westernized education of mathematics.

The limitation of mathematical logic

In general, logic is the study of the principles of valid reasoning and argumentation. In Eurocentric epistemology the basis of logic is formal logic, developed by Aristotle. Based on Plato, Aristotle formulated three interconnected laws of logic:

1. The law of identity: A equals A. A thing is always equal to or identical with itself. Example: Columbus is Columbus.
2. The law of (non)contradiction: A is not non-A. A thing cannot be different from itself. It is a different way of formulating the first law. Example: Columbus is not a dog.
3. The law of excluded middle: If A equals A, it cannot equal non-A. Everything is and must be either one of two mutually exclusive things. Example: a thing cannot be Columbus and a dog. It is either Columbus or a dog.

This type of logic leads to two values: true and false. In the Eurocentric canon the outcome of knowledge production is a concept with a terminology, observations, analysis, theory and ethics. The analysis provides a consistent explanation of the observations that ends in a verdict of one of two values: true or false. This verdict comes after the testing of a proposition, or in Popper's terminology, the falsification of a proposition.
Formal logic is the language in which Euromathematics is expressed. David Hilbert argues that mathematics is not about anything in the physical or even the logical world. It is a formal game played with symbols. In his 1927 presentation on the foundation of mathematics he says: *"No more than any other science can mathematics be founded by logic alone."*[20]
I have offered a fundamental critique of formal logic in paragraph 5.6 (The limitations of Eurocentric logic). In the Global South people also have developed ideas about logic. But they are not acknowledged in the canon of Westernized knowledge.
The Acholi people from Southern Sudan have embedded in their language another view of the principle of the excluded middle. Victor Ocaya explains: *"This principle says that between a statement and its negation there is no other alternative. The Acholi language,*

however, has a peculiar way of repeating an adjective in a manner that seems to suggest a third possible alternative between a statement and its negation. For example:
1 Piny lyet: It is hot. (P)
2 Piny pe lyet: It is not hot. (P)
3 Piny lyet-lyet: It is rather hot. (?)
In (3) the English ''rather'' does not capture the Acholi idea of lyet-lyet, which is somewhere between (1) and (2). Piny lyet-lyet quite unambiguously asserts that it is neither ''hot'' nor ''not hot'' and the law of excluded middle rules out just this possibility. This is evidence against the law of excluded middle, from an Acholi standpoint."[21]

In the ancient Indian philosophy of Jainism the two value logic is regarded as inadequate to understand reality. The world is not only black or white. There are many possible perceptions of reality. No single proposition can capture the complexity of reality. Therefore, it is mandatory to put a prefix to every proposition that expresses this by using the term "syad", which means "in some ways", "from a perspective", "arguably", "possibly". The Jains have developed a seven-value logic based on the notion of true, false and unassertible (cannot be described, it is impossible to make statements about it). The seven values are:

1. Possible, something is true. Example: Columbus is dead.
2. Possible, something is false. Example: Columbus is not dead.
3. Possible, something is true and false. Example: Columbus is dying: dead and
1. not dead.
4. Possible, something is unassertible. Example: We cannot assert whether
2. Columbus is dead or not dead.
5. Possible, something is true and unassertible. Example: Columbus is dead, but
3. we cannot assert that.
6. Possible, something is false and unassertible. Example: Columbus is not dead,
4. but we cannot assert that.
5. Possible, something is true and false and unassertible. Example: Columbus is dying, but we cannot assert that.[22]

If you are accustomed to thinking according to two-value logic, this does not make sense. How can somebody be dead and alive? Very simple, by taking change and continuity into account. Once you do that, formal logic does not work. Look at Columbus breathing, sailing with his ship, kidnapping Tainos, raping Taino women, stealing their gold. You can be certain that he is alive. There are many signs that he is alive.
Look at Columbus when he is dead, lying in his coffin on his way to be buried. His heart has stopped beating. So you can be sure that he is dead.
Now look at the short period in which Columbus is dying. He has difficulty breathing and it seems as if he is going to stop with breathing. You can claim that he is alive, but he is on his way to be dead. Then he stops breathing, but his heart still beats for a short period. Not breathing is a sign that he is dead, but if his heart beats, he is alive. Now his heart stops beating, but he still has brain activity, because the reserve oxygen in his lungs can provide his brain with a few last minutes of energy. If a doctor in these minutes performs CPR by pressing on his chest to get his heart beating again, he might regain a heartbeat. So how do we characterize his position in this short period?
Formal logic cannot deal with this situation, because he is dead and not dead in this period, depending on what criteria you use to define life or death. And sometimes we cannot assert whether he is dead or alive, because the criteria are not clear-cut and can contradict each other. You can define breathing as the most important criterion, but brain activity is also a criterion. You can have some breathing, yet still have brain activity.
The problem lies in the fact that there is not one single criterion that can describe the exact situation in the phase of transition. There are a complex multitude of criteria: heart beat, breathing, brain activity. They all interact in different ways at different times in the transition phase.
Take a less dramatic example: a painting of Columbus where he is ten years old and one where he is fifty years old. Obviously, a ten year-old is not the same person as a fifty year-old. Yet, Columbus at ten years is the same person as Columbus at fifty years. With

formal logic you are at loss to answer the question: are the two paintings about the same person?
With Jain logic you can, because continuity and change is in their concept. Yes, it is the same person. In picture one he is at a stage of growth of a ten year-old (physically, psychologically, culturally). In picture two the same person has evolved, keeping some basic characteristics (his appearance, his genetics, his parents and family, maybe his character) but has changed in other aspects. Change is not always the cancellation of something: an entity does not exist anymore and has changed into something else. Columbus was once alive and then dead. Change can also be an evolution of something where continuity goes along with change.
Jain logic is based on the idea that the essence of an entity does not consist of one element but is made up of multiple elements. It may be that one element changes and others are unchanged. A person who is aging has the same genetics (skin color, eyes, hair texture) but his/her body changes as (s)he grows older. The problem is to find the right elements that constitute the essence of an entity. Clearly in the case of Columbus it is not the way he dressed or the language he spoke. That is something he has in common with many other people. So you end up with a combination of physical, genealogical and social characteristics: skin color, hair texture, genetics, parents, psychological traits.
The Jain proposition that we sometimes cannot assert that something is true or false goes against the Eurocentric canon that in the end research tells you what is true or false. As long as you keep researching you will be able to distinguish true from false. But in physics it has been established that uncertainty cannot be avoided. In nuclear physics (the field of physics that studies atomic nuclei and their constituents and interactions) the German physicist Werner Heisenberg discovered in 1927, that the more precisely the position of some particle is determined, the less precisely its momentum can be known, and vice versa. Momentum is the product of mass and velocity (kilogram/meters per second). If you know exactly where the electron is (its position is certain), you can have no idea how fast it's moving or in what direction (its momentum is completely uncertain). So you either know the position or you know the momentum, but you cannot know both variables at the same time. This is called the Uncertainty Principle of Heisenberg.
The comparison of Eurocentric formal logic and other logical systems brings the question to the fore: what are the implications of mathematics is based on other logical systems than formal logic? How would the discipline look like? That is a decolonial approach to mathematical logic.

Policy implications

Based on the general and specific features of the colonization of mathematics we can now what the policy implications are of decolonizing this discipline. I outline some policy ideas.

1. Research on the contribution of mathematical societies on decolonizing the discipline
In chapter seven of my book I discuss some contribution that have been made in decolonizing mathematics by individual researchers. Associations of mathematicians play a very important role in developing the disciplines. They were first established in the Global North, but they have also flourished in the Global South. Some follow the work developed by their colleagues in the Global North. Others explore new avenues that acknowledges the contributions made by mathematicians in their own region. A good example is the valuable work that the African Mathematical Union has done in decolonizing the discipline. The African Mathematical Union is an African organization dedicated to the development of mathematics in Africa. It was founded in 1976 in Rabat, Morocco, during the first Pan-African Congress of Mathematicians. In 1986 it established the African Mathematical Union Commission on the History of Mathematics in Africa (AMUCHMA) during the second Pan-African Congress of Mathematicians in Jos, Nigeria, to promote research into the history of mathematical sciences in Africa alongside with three other commissions (Mathematics Education, Women in Mathematics, and Mathematics

Olympiad). They published a lot of material on the historiography of mathematics in Africa.[23]
I suggest a research project that looks into how mathematical societies in the global south, and possible in the world, deal with the problem of decolonizing the discipline. There might be a lot of work that has already been done that can help bring the discipline to a higher level.

2. Put the relationship between pure mathematics and 'applied' mathematics on the decolonial agenda

A major difference between Euromathematics and decolonial mathematics is the view on pure mathematics. Pure mathematics detaches mathematics from its empirical reality. I suggest to explore in more depth how this detachment leads to fantasies about empirical reality. I gave the example of the Ramanujan summation, but I guess that more in depth research on specific topics like set theory and string theory, will provide more examples of how math contradicts reality, and thus produces invalid knowledge.

3. Use educational experience of the Global South to produce new textbooks for primary and secondary education

I discusses how in the Global South more instructive methods are used to teach mathematics in primary and secondary education (finger mathematics, stick multiplication). I came across social media post about non-traditional methods of performing calculated by mathematicians from Asia that are sometimes mindblowing. Take this example: 31x51. Normally we would perform the calculation as follows:

```
31
51
----
  31
155
-----
1581
```

One Indian mathematician on social media showed the following technique

```
31     1*1=1
51     3+5=8
-----  3*5=15
1581
```

We have to look into the theoretical construct behind this calculation to judge its validity as an acceptable technique of calculation in education. I suggest to make an inventory of non-Western techniques in teaching math and use the result to make an assessment about possible rewriting of textbooks in primary and secondary education that are currently used.

4. Explore a decolonial mathematics that is not based on formal logic

Euromathematics is based on formal logic. If mathematics uses another foundation of logic, how will it impact the structure and content of the discipline. This is a foundational theoretical problem. Will it turn mathematics upside down?
This has happened in the history of mathematics. Until 1830 geometry was based on classical Greek mathematics that stated that two parallel lines could never intersect. That is true in a flat two-dimensional world. But the world is not flat. In 1830 two mathematicians, János Bolyai and Nikolai Lobachevsky, independently of each other, published articles that proved that in a three dimensional globe two parallel lines can indeed intersect. They established a valid branch of geometry called non-Euclidean geometry, based on totally different principles than Euclidean geometry. Why is it impossible for civilizations outside the West to have developed mathematics on totally different, yet still valid, foundations? In fact, non-Euclidean geometry was being used in India (and Arabs and Europeans) from long before 1830, especially in the works of the Indian mathematician Baskara I (600-680).

I suggest to set up a research project that tackles this highly complex problem of theoretical mathematics. It touches upon the question of reverse engineering. The question in reverse engineering in mathematics is: can we develop alternative systems of mathematics that is not based on Eurocentric concepts yet provides a sound mathematical basis for engineers? This is not an easy task, but not impossible as the development of non-Euclidean geometry has shown.
There have been attempts to understand the theoretical basis for the building of Egyptian pyramids, but with the tools of Euromathematics. A typical example is the discussion about the golden ratio as a theoretical basis for building the Great Pyramid at Giza. Two quantities are said to be in the golden ratio if the ratio of the sum of the quantities to the larger quantity is equal to the ratio of the larger quantity to the smaller one.
Another example of reverse engineering is the work carried out by Ron Eglias on African fractals. A fractal is a geometrical shape that can be subdivided into parts, each of which is (at least approximately) a reduced/size copy of the whole. Fractal shapes are commonly found in nature, from snowflakes to leaves of a tree. Eglias discovered that in African design and architecture the designers and architects used patterns known as fractal geometry. He tried to figure out whether the African fractal designs were intuitive or consciously shaped. And although there are intuitive designs, he discovered that many patterns were consciously constructed and can be understood with the tools of Western fractal mathematics. The Africans never used these tools, so they must have had their own tools in developing the designs. He talked to many designers to figure out what tools they used. This is reverse engineering of a different kind. On the one hand it uses Western mathematical tools to understand the way the designs have been constructed (the regular reverse engineering). On the other hand, it acknowledges that there are other tools and methods (another mathematics) that create these patterns with their own logic and arguments. Sometimes the logic and arguments come from African religious practices. Sometimes they used algorithms that are replicated in Euromathematics.
So reverse engineering is not only a way to understand a design by using Western mathematical tools. Reverse engineering is much more complex. It tries to figure out if there is another basis for mathematics that is not Western yet enables a mathematical analysis to make this type of engineering possible. This is the future challenge for decolonial mathematicians.

5. Develop a critique of the misuse of mathematics in social sciences

In my critique of the misuse of mathematics in social sciences I give a few examples to illustrate my point. I suggest to take a critical look at how mathematics is misused in classical studies of the different disciplines of the social sciences. All these disciplines used the same mathematical tools, mostly descriptive statistics, inferential statistics, linear algebra, calculus and regression analysis. These are important tools, but they can be misused.
In paragraph 10.3 of my book (The methodology of social research) I deal extensively with the classical study of French sociologist Emile Durkheim (1858-1917) on suicide.[24] He collects statistical data on the phenomenon. He uses data from Western countries, notably France, Germany, Denmark, Italy, Belgium, Norway, Austria, Sweden, USA and England. He brings in all the relevant variables: country, region, age, gender, mortality in general and suicide in particular, consumption of alcohol, climate season (Summer, Spring Autumn, Winter), length of the day (hours and minutes of sunlight), time of the day (early morning, later morning, middle of the day, afternoon, evening, night), day of the week (Monday to Sunday), month of the year (January to December), motives for suicide, profession and occupation, level of education, marital status, divorce, military and civilian suicide, means of suicide (hanging, strangulation, drowning, firearms, poison, leaping from a high spot, oxygen deprivation) and finally the relationship between homicide and suicide. From the relationship between the variables, he construes a theory to describe and explain suicide. His conclusion is that suicide has social rather than psychological roots. The social roots of suicide lie in the extent to which an individual is integrated into society. The more integrated an individual is in a society, the

less likelihood there is that suicide will occur and vice versa. However, when integration is too strong, this also can lead to suicide.
Durkheim's study is a model study in sociology. It laid the foundation of how social research should be conducted and how social theories are developed using mathematics, notable statistics. What could possibly be wrong with his approach?
I offered four points of critique of his approach that are not related to mathematics.
The first point is that a researcher should start by explaining the ideological position from which (s)he speaks rather than claiming to be objective. In the case of Durkheim, he is not even aware that he speaks from a specific ideological position, namely that of a secular person from Western Europe.
The second point is that the European experience is not a universal experience.
The third point is the conceptualization of suicide. Durkheim conceptualizes suicide as an act of an individual who chose to kill him/herself and looks at the social causes of this act. Outside of Europe there are examples of groups, not individuals, who chose to kill themselves, but the reasons are political, not social.
The fourth point is the conceptualization of a human being. In the Western secular tradition, a human being is a unity of body and mind. The mind dies when the body dies. In non-secular world views the human is a soul that exists beyond the unity of body and mind. How does suicide fit in those world-views?
Here I want to point to the misconception that statistics reveals the relationship between cause and effect. The correlation between variables in itself is not an explanation. If there is a rising number of storks in a period and a rising number of birth, then the correlation itself is not an explanation of the phenomenon of birth. Pregnancy is the variable for birth. So even if statistically there is a 100% correlation between the number of storks and the number of birth, the mathematics does not provide the explanation. Durkheim is one example. I suggest to undertake these critical studies on a systematic basis.

Conclusion

In this contribution I have tried to provide a model for decolonizing knowledge and use the discipline of mathematics as an example. I argue that we need to move from general notions about decolonizing knowledge to more specific trajectories for decolonizing the disciplines. These trajectories consists of three steps.
First is a critical look at the definition of a discipline. What is the focus of the discipline in produce knowledge and what is the rationale for it.
Second, I discussed four general characteristics of how knowledge was colonized and discussed how these general features are expressed in the discipline of mathematics.
Third, I went into the specific features of how the discipline was colonized and how to decolonized it.
Based on these three steps I came with some suggestions on how to move forward and develop practical policies.
In 1994 the Calouste Gulbenkian Foundation, a Portuguese institution dedicated to the promotion of the arts, philanthropy, science, and education, commissioned a group of scientists to address inadequacies in the organization of the social science disciplines that developed in the nineteenth century and chart out a direction for social scientific inquiry for the next 50 years. The commission was chaired by Immanuel Wallerstein.
In 2010 the European Union funded the ALICE project with €2.4 million that was carried out by the University of Coimbra in Portugal under the leadership of Boaventura de Souza Santos. It looked into experiences in knowledge production in the Global South and the ways in which Europe could learn from these experiences. There is in the Global North some desire to open up the social sciences.
Decolonizing The Mind is about reconstruction the whole system of knowledge production and begin on the level of the discipline.

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[5] Idem.
[6] Russell, B. (2010): Mysticism and Logic and Other Essays. The Floating Press. Berlin, p. 64.
[7] Idem, p. 63.
[8] Crump, Th. (1997): The anthropology of numbers. Cambridge Univ. Press. Cambridge, p. 47.
[9] I discuss this documentation in paragraph 8.2 (The African roots of Western civilization) of my book. See Hira, S. (2023).
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[11] Cited in Hira, S. (2023), p. 250.
[12] Idem, p. 237.
[13] Idem, p. 144.
[14] Idem.
[15] Idem, p. 239.
[16] Idem, p. 240.
[17] Idem.
[18] Idem, p. 240-241.
[19] Idem, p. 242.
[20] See https://www.marxists.org/reference/subject/philosophy/works/ge/hilbert.htm.
[21] Cited in Hira, S. (2023), p. 156.
[22] Idem.
[23] See https://www.math.buffalo.edu/mad/AMU/index.html.
[24] Hira, S. (2023), p. 345-350.