The Amalgam of Faith and Reason: Euclid's *Elements* and the Scientific Thinker

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Abstract Problematizing the truths of mathematics education is one of the roles of the philosophy of mathematics education. That mathematics education is a matter of reason and science—not of faith and religion—and that mathematics is timeless, universal and immutable, objective knowledge that is independent from people's work and sense-making are two strong taken-for-granted statements that navigate in common understandings of mathematics education. Using a Foucault-Deleuze inspired analytical strategy, we examine the contention that mathematics education for the making of the rational and logical child intertwines with what was ought to be the 'scientific thinker' to Christianity. We focus on how Euclidean geometry, taken as a proper method of inquiry amalgamated with the Christian worldview to provide explanations about the natural world. The effect of power is the making of the Modern scientific thinker.

Keywords Platonism in mathematics education · Faith · Sacralisation of mathematics · Scientifization of education

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Introduction

Part of doing philosophy of mathematics education, as Ernest et al. (2016) express, is about a systematic analysis and a critical examination of problems that are fundamental to mathematics education. It enables us:

> [T]o see beyond the official stories about the world, about society, economics, education, mathematics, teaching and learning. It provides thinking tools for questioning the *status quo*, for seeing 'what it is' is not 'what has to be'; to see that the boundaries between the possible and impossible are not always where we are told they are. (Op. cit., p. 4)

Such phrasing resonates with our positioning on the cultural politics of mathematics education. We are interested in exploring the practices of mathematics education by making evident how mathematics and its inclusion in the school curriculum made part of the technologies of power/knowledge for the making of Modern subjectivity (e.g., Andrade-Molina & Valero, 2017; Valero & Knijnik, 2016). Blurring the division between fields of study such as history, cultural studies, educational sciences, and mathematics education research itself, we broaden the possibilities to understand schooling as a social institution in concrete historical configurations, and the desire to strive for the fabrication of rational, enlightened subjects. Our analytical strategy, drawing from the toolboxes of Foucaultian and Deleuzian studies, invite to historicize the present in a rhizomatic search for how rationalities about mathematics and school mathematics have been constituted and have found a solid place in the current narratives of the undeniable necessity of mathematics for citizenship, society, economics now and in the future. From this perspective, the philosophy of mathematics education is concerned with moving beyond the official stories about what are the objects and subjects of mathematics education, and challenge the *status quo* of what has come to be accepted as taken-for-granted truths about school mathematics.

Elsewhere (Andrade-Molina & Ravn, 2016) we have discussed the value granted to Euclidean geometry for the shaping of scientific thinking since the structure of the *Elements* was taken, by scientific research, as a proper method of inquiry. This is important in understanding how in the desire for making the rational subject through education, the scientific and mathematical rationalities have been intertwined through history. Now, we take a step further in problematizing how modern narratives about the fabrication of the 'reasonable citizen' (Andrade-Molina, 2018) through the learning of school mathematics bring science, mathematics and religion together. Our contention is that current naturalized truths about the role of mathematics education for the making of the rational and logical child are intertwined with what was ought to be the 'scientific thinker' to Christianity. We problematize two truths that navigate in the way mathematics in the school curriculum and educational practices are currently conceived of. First, school mathematics forms the rational mind, and such formation is distinctly separated from faith and religion. In other words, mathematics education is conceived a secular project of rationality, advancing the Enlightenment for the expansion of human reason over obedience to the rule of faith. Second, it is the idea that mathematics is timeless, universal and immutable, objective knowledge that is independent from people's work and sense-making. In other words, particular notions of mathematics are embedded in the common practices of school mathematics despite efforts to introduce pedagogies rooted on the socio-cultural-political theories of knowledge and learning (e.g., Planas & Valero, 2016; Radford, 2008). We problematize these truths as interconnected statements tracing the historical justifications for the inclusion of Euclidean geometry as a topic of teaching and learning.

The dominant narratives of mathematics education position mathematics as an objective knowledge completely independent from faith, ideologies, culture, society or politics. However, the teaching of mathematics, in particular of Euclidean geometry, shaped scholastics and the expansion of Christianism on a quest for certainty and for a closer understanding of God. The view of mathematics as the language used by God in Christianity had a great impact in the forming of Western, Modern education. On the one hand, the Modern languages of education as cultural expressions emerged in an amalgamation of Christian notions of morality belonging to the different confessional orders in Europe in the 18th century and political ideals (Tröhler, 2011). Education as a tool of State governing through the fabrication of notions of the "moral man" also articulated the growing desire for scientific and mathematical knowledge (Valero & García, 2014). On the other hand, the quest for God in natural philosophy also promoted the advance of mathematics (Kvasz, 2004). Here we will explore the entanglement between modern discourses of mathematics education and the discourses on faith from Christianity.

Setting the Scene

Before beginning to unpack the discourses on faith, we want to set the scene. All taken events occur in a time and place where there is no such thing as 'scientists', yet. What we currently identify as science had until the 18th century occurred in the realm of "natural philosophy" (Beltrán, 2009) or "natural history" (Foucault, 1971). And 'the Philosopher' *par excellence* of that time was Aristotle, given that his work was taken as the "eminent representation of science" (Beltrán, 2009, p. 284, our translation). His ideas "transformed the way the West thought about the world and its operations" (Grant, 2004, p. 14). For many years, the *Elements* of Euclid were considered as a particular expression of Aristotelian logic. Scholars made efforts to establish 'one-to-one correspondence' between Aristotelian logic—axiomatic—and Euclid's postulates (Gómez-Lobo, 1977), sometimes assuming that Euclid had put Aristotle's 'dictum' into practice while configuring the *Elements* (Mueller, 1969).

According to Descartes, what Euclid accomplished should be understood as a model for inquiry in all areas (Toulmin, 2001). His insistence on the "Euclidean model of knowledge planted some seeds in natural science between 1600 and 1650" (Op. cit., p. 43). Since then and until the 19th century, the *Elements* were "taken as the paradigm for establishing truth and certainty. Newton used [its form] in his Principia, and Spinoza in his Ethics" (Ernest, 1991, p. 4). The geometry on Euclid's books became a logical system:

> [The *Elements*] is one of the great achievements of the human mind. It makes geometry into a deductive science and the geometrical phenomena as the logical conclusions of a system of axioms and postulates. The content is not restricted to geometry as we now understand the term". (Chern, 1990, p. 679)

This is precisely what other philosophers saw in Euclid's books: Content not only restricted to geometry. The *Elements* became a guide to produce science through a particular way of describing reality. And its status as an example of Aristotelian logic led it to expand throughout most fields of inquiry. That Euclid's axiomatic was the model to produce secure knowledge became a part of Western culture and appeared repetitively in many cultural expressions. For instance in Botticelli's fresco St. Augustine in his study from 1480.

> Botticelli portrayed Augustine as a scholar-saint wearing clerical robes with an open treatise on geometry and a weight-driven clock nearby. He looks heavenwards, seeking the order that the Christian God (like Plato's demiurge) imposed on creation by dividing light from darkness. (Gamwell, 2015, p. 476)

The Amalgamation of Faith and Science

In the Middle Ages, Aristotelian logic was perceived as "the indispensable instrument for demonstrating theoretical knowledge" (Grant, 2004, p. 10). The use of principles instead of axioms led Aristotle's work to be considered as an axiomatization of science (Geréby, 2013). On the one hand, as aforementioned, natural philosophers relied on the work of 'the Philosopher' for their inquiries. Philosophy was viewed as a "wish to gain a rational understanding of the world in which we live, and the fundamental processes at work in nature, society and our own way of thinking" (Grant & Woods, 2002, p. 25). So, to understand the Universe is to comprehend the nature of things "by observation and reflection, to discover the causal principles, the forces, the powers and potentialities of the things that govern their behaviour" (Tiles, 2003, p. 351). On the other hand, there was a conflict among Christians on the symbolic or literal reading of the Bible (Midgley, 2005). Within this conflict, 'science' was taken as dangerous given that God forbid Adam and Eve to eat from the Tree of Knowledge or as archangel Raphael told Adam to be 'lowly wise' when he began questioning the nature of the universe (Wolpert, 2013). With the flourishing of natural philosophy, conservative theologians "were alarmed […]. They were concerned that Aristotle's natural philosophy was circumscribing God's absolute power to do anything" (Grant, 2004, p. 12). According to Murray and Rea (2016, p. 2), "early Christian thinkers such as Tertullian were of the view that any intrusion of secular philosophical reason into theological reflection was out of order". Natural philosophy sought for a kind of certainty that faith could not grasp.

The Christian Church took its wishes of expansion to spread the evangelic message as an agreement between faith and reason (Beltrán, 2009). And the Church used Aristotle's language to articulate its documents without an interest on "establishing the truth […] but to only capitalize some possibilities of the Greek cosmogony in conditions to make more explicit the sense of the proper mysteries of religion" (Op. cit., 2009, p. 283, our translation). The need to reconcile faith and 'science' emerged in connection to this desire of expansion:

> [S]ome of the greatest Christian theologians clearly had defended the position that the concrete contents of religious truth should be based on reason alone. […]A rationalist position was particularly tempting in times in which there was a clear awareness that a legitimate interpretation of "revelation"—of scripture and tradition—was itself a work of reason. If the last meaning of scripture was allegorical, tropological, and anagogical, then this meaning had to be based on rational arguments, which alone could have the power to transcend literal meaning. (Hösle, 2013, pp. 2–3)

Thomas Aquinas balanced a Catholic discourse of faith and science rooted in Aristotelian philosophy; he believed that God's existence was rationally demonstrable (Hösle, 2013). How else can one approach God, who is unreachable by the senses, if not by the use of logic and reason? In this need of amalgamation, "Aquinas' *Summa Contra Gentiles* is a good example of how dialectical investigations have been carried out in philosophy and theology" (Bovell, 2010, p. 70). The claims made by either theology or philosophy under the Thomistic model, were not believed to conflict anymore (Murray & Rae, 2016), since "some truths can be known only through faith, some can be known only through reason, and some can be known through either faith or reason" (Garcia, 2003, p. 623). In his *Summa,* analogue to philosophy, "theology consists of (theological) principles, and (theological) theses derived from these principles" (Geréby, 2013, p. 175):

> The genius of Aquinas articulated itself in the fact that he transformed the insecurity of Christianity that resulted from the discovery of the Aristotelian corpus, […], into a positive development and, despite many hostilities that culminated in suspecting him of heresy, conceived a great synthesis of Christianity and Aristotelianism that satisfied both the religious need and the need for knowledge of the empirical reality. (Hösle, 2013, p. 151)

Prior to Aquinas, Augustine established a connection between faith and natural philosophy where philosophy complemented theology "but only when these philosophical reflections were firmly grounded in a prior intellectual commitment to the underlying truth of the Christian faith" (Murray & Rea, 2016, p. 2). His work had a significant impact in Christianity (Finocchiaro, 1980), "in the process that would eventually lead to the rationalization of medieval theology" (Grant, 2004, p. 39). Augustine's theory of illumination is embedded in Malebranche and Descartes' works (Spade, 1994). Grant (2004) argues that Augustine had a Platonic interpretation of the 'valid rules of logic', which made him believed that

> [L]ogic was a valuable tool that would enable them to infer the correct conclusions from the initial [Scriptural or doctrinal] premises […] With this attitude toward logic and reason, Augustine was not reluctant to use analytic tools – especially Aristotle's categories – in his analysis of doctrinal truths, as he did in one of his greatest works, the fifteen books of *On the Trinity*. (p. 39)

The amalgamation of faith and science, through Aristotelian logic, fulfilled the Christian need to base ‘revelations’ on reason and logic. This allowed adding certainty to the allegorical interpretation of the Bible. From this merging, thinkers of the world of faith made contributions to the world of empirical philosophies, for example, Aquinas’ and Augustine’s contributions to astronomy (see Campion, 2014). And despite being regarded as two separated, even opposite, fields of knowledge in modernity, both are not “games that can be played independently of each other. Both are about truth, and reality. Their divided claims cannot stand with the assumption of there being one single reality” (Geréby, 2013, p. 177).

When Scholastics Met Euclid

A religious search for knowledge and certainty has not to be reduced only to a simplistic discussion about God, or to what we currently consider theology as “the science of God” (Hösle, 2013). Within the Church’s structure, Bishops, the teachers of Christianity, had a preeminent authority among scholastics to provide instruction. Scholastics were not to rely only on their faith and their beliefs. And so, ‘students’ of the religious orders were educated under the oeuvre of classical pagan philosophers of Ancient Greece, for example, Plato’s theories of the soul: “Platonism held that the soul could exist apart from the body after death. This would obviously be appealing to Christians, who believed in an afterlife” (Spade, 2016, par. 9). Scholastics were encouraged to study ‘sciences’: geometry, astronomy, Aristotelian logic, Platonic tradition, among others (Clavius, 2002). They were also encouraged to translate and reproduce the most prominent books of the time. For example Boethius’ translations from Greek into Latin of Aristotle’s and Plato’s most dominant works, including Boethius’ commentaries to ‘illuminate’ their philosophies (Marenbon, 2009). They also translated the *Element*s of Euclid, since they recognized in these books more than just geometrical knowledge of Ancient Greece. They used them to study proof, common notions, and axiomatics; and through such study the reasonable and scientific thinker needed for Christianity could be shaped:

> [The student] offer new proofs of some of the propositions of Euclid, thought out by himself; in these places, let praise be given to those who best solve the problem proposed, or who commit the fewest false syllogisms, which occur not rarely, in the invention of the new proofs. For it would happen thus, that they would become not a little eager for these studies, when they see such honor given to them, and at the same time would understand the eminence of these same studies, and they would make greater progress in these things through this exercise. (Clavius, 2002, p. 467)

The structure of the *Elements* became a very powerful model for achieving certainty through axiomatics. The *Elements* began intertwine with the productions of faith. Scholastic made “efforts to build theological systems from scriptural texts as plane geometry is built from the postulates of Euclid” (Pals, 2011, p. 919). Nicholas of Amiens, a French theologian from the 12th century, wrote

Ars Catholicae Fidei [Art of catholic faith] based on Euclid's books. Amiens provided a sequence of arguments to set the rules of the Catholic faith by assembling "definitions [descriptions], postulates [petitiones], and common notions, or axioms [conceptions]" (Grant, 2004, p. 67). Aquinas' book *Summa Contra Gentiles* became the best example of the amalgamation of faith and science, theology and philosophy. According to Bovell (2010), Aquinas' work is rarely related with Euclid's books, but his *Summa Contra Gentiles* 'mimics' the configuration of the *Elements*. "These seem the syntactical equivalents to Euclidean proofs of demonstration and play analogously the same role in Aquinas as proofs of demonstration do in Euclid" (Op. cit., pp. 70–71). As his predecessors, Herbert de Cherbury, an English philosopher of the 17th century, borrowed the term 'common notions' from Euclid as the foundation of reasoning in his book *De veritate* (Serjeantson, 2001). De Cherbury contends that "the being of God is indicated by the structure of reality" (Pailin, 1983, p. 198) and, so, his existence can be determined by reason and by observation of the natural world (de Cherbury, 1633).

To Christianity the *Elem*ents were special; they encapsulated "a form of reasoning, and a handmaiden of natural theology" (Cohen, 2007, p. 164). It had common notions, rigorous mathematical proofs, and a deductive system.

> [C]ommon notions are the ultimate and indisputable principles by which understanding ought to be governed and are God's way of ensuring that every person has what is essential 'for this life and for life eternal'. They are not, however, principles which everyone is always aware of. They emerge to consciousness only when the mind has been aroused by appropriate experiences. What is common to all people is the basic structure of understanding through which any individual, suitably provoked, may come to recognize them and perceive their certainty. (Pailin, 1983, p. 198)

In this regard, it is not rare that the *Elements* were used in missions to expand Christianity. The Italian Jesuit Matteo Ricci recognized in Euclid's books "something different, namely, propositions presented in order and so definitely proven that even the most obstinate could not deny them" (Gallagher 1942, p. 471). As an example, the Elements were brought to China as a mean to introduce Aristotelian logic (Yuan, 2012). Matteo Ricci and the Chinese mathematical scholar Xu Guangqi translated the firsts books into Chinese. The Jesuits selected these books to deal with the main differences between Western and Chinese culture. According to Yuan (2012), Chinese logic is pragmatic, inscribed in a world of concrete objects that is always flowing, always changing. On the contrary, Aristotelian logic is a hierarchical order system of abstract concepts. According to Gallagher (1942), Euclidean geometry pleased Chinese as much as any other form of knowledge.

> Though no Chinese understood Aristotelian logic at the beginning, *Jihe yuanben* [Euclid's book I–VI], as a mathematical text and source of logical training, became more and more popular in China over the last four hundred years […] By contrast, studying Aristotelian logic itself is still considered as difficult work. (Yuan, 2012, pp. 83–84)

Sacred Mathematics and the Path to God

To Christianity, the *Elements* were not only an instrument to teach scientific reasoning through Aristotelian logic for the shaping of the scientific thinker. Neoplatonism helped giving a different status to geometry, and mathematics was conceived as a form of thinking for approaching Immutable Truths (Grant, 2004). The Greek Proclus based his philosophy on Plato's idealist thoughts, the Neoplatonic, in which, "beings exist in a cave of impaired perception, a profane realm of limited, imperfect things: matter, decay, ever-changing shapes" (Cohen, 2007, p. 19). To Proclus, human existence occurs in the realm of muddled existence. The divine, above humans, is a 'sphere' of purity and eternal Truth. And "[m]athematics plays a special role in this divided universe—it ascends from the world of impermanence to this higher, heavenly plane. (Cohen, 2007, p. 19). The notion of infinity was considered as negative in Ancient Greece, however it was taken as a path to God for medieval scholars: "Theology made the notion of infinity positive, luminous, and unequivocal [infinity] was interpreted as the consequence of human finitude and imperfection" (Kvasz, 2004, p. 114). For example Leibniz's soul-like monads metaphysical system, in which "God is needed to ensure that the components of the universe interact as harmoniously as possible" (Francks & Macdonald, 2003, p. 665). Or Descartes attributing God a fundamental role in the conservation of momentum.

> Descartes is one of the earliest philosophers who sees in the conservation laws of physics an expression of God's immutability and even if he adduces as an example the conservation of momentum, he still regards momentum as a scalar magnitude, not as a vector. Therefore, he can believe that the *res cogitans* may influence the mere direction of the *spiritus animales* without altering the quantity of momentum. (Hösle, 2013, p. 99)

Natural philosophers "saw all regular phenomena as marks of God's Rational Order" (Toulmin, 2001, p. 51), It is in this sense that Christianity sacralized mathematics as the path to access divinity. The realm of the primary causes, the cause without cause, is reserved to God. But the realm of the second causes, the natural world derived from the first cause, can be understood, studied and known through science and reason. Conservative theologians saw in the natural order of things a clear proof of the hands of God regarding the creation of the Universe and of humanity. Even today, primary causes are questions that science cannot solve for Christianity. Pope John Paul II claimed, at a conference about cosmology held in the Vatican in 1981, that "there is needed that human knowledge that rises above physics and astrophysics and which is called metaphysics; there is needed above all the knowledge that comes from God's revelation" (John Paul II, 1981, par. 5). And he told the participants they could "study the evolution of the universe after the big bang, but [physicists] should not inquire into the big bang itself because that was the moment of creation and therefore the work of God" (Hawking, 2003, p. 67).

Reading the *Elements* as the vehicle to reach an understanding of the "first cause", enables to describe the connection that mathematics establishes between man and God:

> John Dee inherited this occult quest and was convinced that mathematics was the special language that would transport its conjurer to that higher plane of divine truth. Dee's introduction to Euclid's Elements encapsulated the purpose and efficacy of mathematics in a manner that resonated with the mathematical idealism of the early Victorian age […] Dee divided all things in the universe into three categories: the natural, the supernatural, and the mathematical. Natural things are perceivable, changeable, and divisible. Supernatural things are invisible, immutable, and indivisible. Mathematical concepts occupy a critical middle position between the natural and the supernatural, thus mediating between these realms. (Cohen, 2007, pp. 21–22)

The *Elements* were not only to teach scholastics how to reason and to be logical, since it was believed that the "knowledge of God cannot be achieved by means of science, it was thought to be beyond the reach of reason" (Hösle, 2013, p. 3). Geometry was thought to be the architecture of divinity. Through the understanding of natural things scholastics could approach the purity and eternal realm of God's structure of the universe. The medieval expression from 13th century, the great architect of the universe or God the geometer, portrayed God with a compass in his right hand in an act of creating the universe, which entails that he first created geometry as his own language for structuring the cosmos and mankind. And since then this idea has navigated widely in a variety of expressions of Western culture, from Christian medieval expression of God as the geometer of the Universe, to Mandelbrot's fractal geometry of nature theory (Mandelbrot, 1983) to the molecular composition of the DNA.

In the book *The fractal geometry of nature*, it is set a discussion about how "nature has played a joke on the mathematicians. The 19th century mathematicians may have been lacking in imagination, but Nature was not" (Mandelbrot, 1983, p.3), in such discussion Mandelbrot agues that "imagination tires before Nature" (Op. cit., p.4). The manifesto Mandelbrot poses is the one of mathematics as a dual constitution, one from Nature—that needs to be study—and the other from human invention—mathematicians discovering what is already made in Nature. Here Mandelbrot uses the medieval icon of *God the geometer* with the inscription "here God creates circles, waves, and fractals" (Op. cit., p. c1). Such interpretation gives to fractals an origin from the divine. The latter is a modern example of the sacred character given to geometry "The [DNA] helix, which is a special type from the group of regular spirals, results from sets of fixed geometric proportions" (Lawlor, 2002, p. 4). "Fixed" geometric proportions not necessarily mean that DNA is a creation of God, but gives to geometry a Platonic character, a supernatural thing, according to Dee's division. As Lawlor (2002) continues these fixed geometric proportions "can be understood to exist a priori, without any material counterpart, as abstract, geometric relationships. [The helix] existence is determined by an invisible, immaterial world of pure form and geometry" (p. 4).

In medieval schools, mathematics was included as part of the quadrivium (astronomy, geometry, arithmetic, and music) and it was taught by scholastics. The aim was to "yield knowledge concordant with both human reason and the Christian faith" (Garcia, 2003, p. 620). The Jesuit mathematician Clavius expressed that "one cannot understand various natural phenomena without mathematics" (Smolarski, 2002, p. 258). A need to teach geometry and mathematics emerged: Mathematics to achieve Truth in the divine.

> [B]ecause of [mathematics] participation in both the perfect and imperfect spheres of existence, mathematics provides a mental pathway for ascending out of the material realm and attaining an ideal comprehension of the universe. (Cohen, 2007, p. 20)

The Discourses on Faith

Aristotelian logic and Neoplatonism gave to Christianity a solid foundation on which to ground their beliefs on the existence of God. Both gave to their philosophy the certainty needed in the Middle Ages. The *Elements*, taken as the perfect example of Aristotle's understanding of science, helped in shaping the 'scientific thinker'. *Geometry* was taken as a deductive science with logical conclusions (Chern, 1990). And so, Euclid's books were taken to be the core of any science, to Christianity. The learning of common notions, propositions, axioms, and proof enable scholastics to engage in scientific (philosophical) discussions with the books produced by Christianity. For example, de Cherbury belief in God "is not derived from history, but from the teachings of the Common Notions" (Pailin, 1983, p. 200). The discourses on faith about science became intertwined with what we know today as science.

Medieval schools emerged as a previous step towards the formation of the university. The latter, "was a wholly new institution that not only transformed the curriculum but also the faculty and its relationship to state and church" (Grant, 2004, p. 29). And although it seems that Christian beliefs, in contemporaneity, have been distinctly separated from school curricula, it seems fair to conclude that there is no religious beliefs been reproduced in schools nowadays. Buchardt (2016, p. 1) argues that, while "it is common sense in the educational field that religion before modernity has played a central role in education, opinions differ when turning to a perspective of the present" She argues that the apparent secularization of education through its increased scientification has created the idea that contemporary schooling is about science—even in subjects such as "Religion". However, a close analysis would reveal how religious notions guiding education reconfigured into new, secularized and scientified forms of school subjects (Buchardt, Tröhler, & Valero, 2016). In the case of school mathematics, the discourses on faith that have historically made part of the amalgamation of religion and science through mathematics are the connecting thread that binds faith with reason. Such fine thread remains though unexposed in current understandings of school, school mathematics, mathematics and science, although some work has pointed in that direction (e.g., Peñaloza & Valero, 2016; Restivo, 2008; Valero & García, 2014).

As we showed, the teaching of mathematics shaped scholastics and supported the expansion of Christianism on a quest for certainty and for a closer understanding of God. The historical amalgamation of faith and reason through the articulation of theology and science in Christianity positioned Euclidean geometry and its axiomatics as a privileged element in education for the making of a desired knowledgeable, scientific and faithful self. In schools, mathematics is still mainly thought of as a sacred, timeless, universal, objective knowledge, and an immutable truth in the sense of Christianity. It is not the path to access the purity of God, but to access the purity of the Platonic world of ideas. School mathematics seems not to be mutable, as the history of mathematics and mathematics education reveal. Despite this, it keeps on being conceived as fixed. Some kind of essence seems to escape the possibility of transformation. Not all students nowadays are meant to be mathematicians, nonetheless all are expected to recognize in mathematics the key to access knowledge… just as medieval scholastics did.

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References

Andrade-Molina, M. (2018). Mindniac: The reasonable citizen of schooling (Chilean edition). *The Mathematics Enthusiast, 15*(1), 36–53.

Andrade-Molina, M., & Ravn, O. (2016). The Euclidean tradition as a paradigm for scientific thinking. *Philosophy of Mathematics Education Journal, 30*. http://socialsciences.exeter.ac.uk/education/research/centres/stem/publications/pmej/pome30/index.html.

Andrade-Molina, M., & Valero, P. (2017). The effects of school geometry in the shaping of a desired child. In H. Stahler-Pol, N. Bohmann, & A. Pais (Eds.), *The disorder of mathematics education. Challenging the socio-political dimensions of research* (pp. 251–270). New York: Springer.

Beltrán, O. (2009). Teología y ciencia en la obra de Santo Tomás de Aquino. *Revista Teología. XLV, 1*(99), 281–299.

Bovell, C. (2010). Two examples of how the history of mathematics can inform theology. *Theology and Science, 8*(1), 69–85.

Buchardt, M. (2016). Religion and modern educational aspirations. In M. Peters (Ed.), *Encyclopedia of educational philosophy and theory* (pp. 1–6). Springer.

Buchardt, M., Tröhler, D., & Valero, P. (2016). Bodies, souls and the languages of modern schooling: Between sacralization and scientification. In *Symposium presented at the International Standing Conference for the History of Education*, Chicago, August 17–20.

Campion, N. (2014). Aquinas, Thomas. In T. Hockey, V. Trimble, T. Williams, K. Bracher, R. Jarrell, J. Marché II, J. Palmeri, & D. Green (Eds.), *Biographical encyclopedia of astronomers* (pp. 91–92). New York: Springer.

Chern, S. (1990). What is geometry? *The American Mathematical Monthly, 97*(8), 679–686.

Clavius, C. (2002). Historical documents, part II. Two documents on mathematics. *Science in Contest, 15*(3), 465–470.

Cohen, D. (2007). *Equations from God. Pure mathematics and victorian faith*. Baltimore: The Johns Hopkins University Press.

de Cherbury, H. (1633). *Herbert, De veritate, prout distinguitur a revelatione, a verisimili, a possibili, et a falso*. London.

Ernest, P. (1991). *The philosophy of mathematics education*. New York: Falmer Press.

Ernest, P., Skovsmose, O., van Bendegem, J. P., Bicudo, M., Miarka, R., Kvasz, L., & Moeller, R. (2016). *The philosophy of mathematics education*. Springer International Publishing.

Finocchiaro, M. (1980). *Galileo and the art of reasoning*. London: D. Reidel Publishing Company.

Foucault, M. (1971). *The order of things. An archaeology of the human sciences*. New York: Vintage Books.

Francks, R., & Macdonald, G. (2003). Spinoza and Leibniz. In N. Bunnin & E. P. Tsui-James (Eds.), *The Blackwell companion to philosophy* (2nd ed., pp. 658–670). Blackwell Publishing.

Gallagher, L. (1942). *China in the sixteenth century: The Journals of Matteo Ricci, 1583–1610*. New York: Random House.

Gamwell, L. (2015). Geometries of beauty. *Nature, 528*, 476–477.

Garcia, J. (2003). Medieval philosophy. In N. Bunnin & E. P. Tsui-James (Eds.), *The Blackwell companion to philosophy* (2nd ed., pp. 619–633). Blackwell Publishing.

Geréby, G. (2013). Medieval philosophies. In *What are they, and why? Philosophy today* (pp. 170–181).

Gómez-Lobo, A. (1977). Aristotle's hypothesis and the Euclidean postulates. *The Review of Metaphysics, 30*(3), 430–439.

Grant, E. (2004). *God and reason in the middle ages*. Cambridge: Cambridge University Press.

Grant, T., & Woods, A. (2002). *Reason in revolt: Dialectical philosophy and modern science* (Vol. I). New York: Algora Publishing.

Hawking, S. (2003). *The illustrated theory of everything*. CA: New Millennium Press.

Hösle, V. (2013). *God as reason*. Notre Dame: University of Notre Dame Press.

John Paul II. (1981). *Address to the plenary session and to the study week on the subject 'cosmology and fundamental physics' with members of two working groups who had discussed 'perspectives of immunisation in parasitic diseases' and 'statement on the consequences of the use of nuclear weapons'*. http://www.casinapioiv.va/content/accademia/en/magisterium/johnpaulii/3october1981.html.

Kvasz, L. (2004). The invisible link between mathematics and theology. *Perspectives on Science and Christian Faith, 56*(2), 111–116.

Lawlor, R. (2002). *Sacred geometry. Philosophy and practice*. London: Thames & Hudson.

Marenbon, J. (2009). *The Cambridge companion to Boethius*. Cambridge: Cambridge University Press.

Mandelbrot, B. (1983). *The fractal geometry of nature*. New York: W.H. Freeman and company.

Midgley, M. (2005). Vision of embattled science. In R. Levison & J. Thomas (Eds.), *Science today. Problem or crisis?* (pp. 19–27). New York: Routledge.

Mueller, I. (1969). Euclid's elements and the axiomatic method. *The British Journal for the Philosophy of Science, 20*(4), 289–309.

Murray, M. J., & Rea, M. (2016). Philosophy and Christian theology. In E. N. Zalta (Ed.) The stanford encyclopedia of philosophy (Winter 2016 Edition). https://plato.stanford.edu/archives/win2016/entries/christiantheology-philosophy/.

Pailin, D. (1983). Herbert of Cherbury and the Deists. *The Expository Times, 94*(7), 196–200.

Pals, D. (2011). Seeing things their way: Intellectual history and the return of religion. *Church History, 80*(4), 918–921.

Peñaloza, G., & Valero, P. (2016). Nihil obstat. Las ciencias naturales escolares y la fabricación del ciudadano católico en Colombia. *Educação Unisinos, 20*(1), 3–13. https://doi.org/10.4013/edu.2016.201.01.

Planas, N., & Valero, P. (2016). Tracing the socio-cultural-political axis in understanding mathematics education. In A. Gutiérrez, G. C. Leder, & P. Boero (Eds.), *The second handbook of research on the psychology of mathematics education. The journey continues* (pp. 447–479). Rotterdam: Sense Publishers.

Radford, L. (2008). Culture and cognition: Towards and anthropology of mathematical thinking. In L. D. English & M. G. Bartolini Bussi (Eds.), *Handbook of international research in mathematics education* (2nd ed., pp. 439–464). New York, NY: Routledge.

Restivo, S. P. (2008). Minds, morals, and mathematics in the wake of the deaths of Plato and God: Reflections on what social constructionism means, really. In A. Chronaki (Ed.), *Mathematics, technologies, education. The gender perspective* (pp. 37–43). Volos: Thessaly University Press.

Serjeantson, R. W. (2001). Herbert of Cherbury before Deism: The early reception of the De veritate. *The Seventeenth Century, 16*(2), 217–238.

Smolarski, D. (2002). Teaching mathematics in the seventeenth and twenty-first centuries. *Mathematics Magazine, 75*(4), 256–262.

Spade, P. V. (1994). Medieval philosophy. In A. Kenny (Ed.), *The Oxford illustrated history of philosophy* (pp. 55–105). Oxford: Oxford University Press.

Spade, P. V. (2016). Medieval philosophy. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Spring 2016 Edition). https://plato.stanford.edu/archives/spr2016/entries/medieval-philosophy/.

Tiles, M. (2003). Philosophy of mathematics. In N. Bunnin & E. P. Tsui-James (Eds.), *The Blackwell companion to philosophy* (2nd ed., pp. 345–374). Blackwell Publishing.

Toulmin, S. (2001). *Return to reason*. Harvard University Press.

Tröhler, D. (2011). *Languages of education. Protestant legacies, national identities, and global aspirations*. New York: Routledge.

Valero, P., & García, G. (2014). El currículo de las matemáticas escolares y el gobierno del sujeto moderno. *Bolema, 28*(49), 491–515.

Valero, P., & Knijnik, G. (2016). Mathematics education as a matter of policy. In M. A. Peters (Ed.), *Encyclopedia of educational philosophy and theory* (pp. 1–6). Singapore: Springer Singapore.

Wolpert, L. (2013). The unnatural nature of science. *European Review, 21*(51), S9–S13.

Yuan, J. (2012). Aristotelian logic in China—A case study of the Chinese translations of Euclid's Elements. *Journal of East-West thought, 2,* 81–94.

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