REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

The Limits of Formalism: A Phenomenological Critique of Mathematical Meaning and Intelligibility

[1*]Issadeen M.L, [2]Dr. K. Raveendran,

[1*]Ph.D. Research Scholar, Department of Philosophy, Annamalai University.
E-mail: issadeen1968@gmail.com.
[2]Assistant Professor, Department of Philosophy, Annamalai University.

Abstract
This article presents a comprehensive phenomenological critique of formalism in the philosophy of mathematics, arguing that purely syntactic interpretations fail to account for the genesis and structure of mathematical meaning. Formalism, primarily associated with David Hilbert, conceives of mathematics as the manipulation of symbols according to explicit rules; however, it omits examining the conditions under which these symbols acquire meaning. Drawing on Edmund Husserl's transcendental phenomenology and engaging with both Gottlob Frege's logical analyses and Ferdinand de Saussure's linguistic contributions, this study argues that mathematical intelligibility is grounded in a pre-symbolic realm of ideal structures, constituted within acts of consciousness.
The article also proposes a tripartite model in which forms act as the ideal ground of meaning, symbols serve as mediators of formal operations, and words provide discursive expression. Through this conceptual framework, it is demonstrated that formalism presupposes precisely what it seeks to eliminate: a prior realm of intelligibility that cannot be reduced to mere symbolic manipulation. By reconstructing the fundamental processes of emergence, stabilization, and communicability of mathematical meaning, this work establishes both the limitations of formalism and the need for a phenomenological alternative.

Keywords;Mathematical Phenomenology, Formalism, Mathematical Meaning, Intentionality, Symbolic Representation, Ideal Forms

Introduction

To further deepen the introductory framework, it is essential to situate the problem of mathematical logic within the broader historical context of philosophical reflection on knowledge and reality. From the early insights of Plato, who regarded mathematics as pertaining to the realm of intelligible regularities, to the critical analyses of Immanuel Kant, who grounded mathematics in a priori systems of perception, the question of how mathematics fulfills its specific and universal requirements has remained central to philosophical inquiry[1]. Underlying all such philosophical commitments is the recognition that mathematical knowledge cannot be confined to empirical observation alone, but rather entails a distinct mode of rational insight.

The advent of modern logicism, and the subsequent emergence of formal systems, marked a significant shift within this tradition. Through the works of Gottlob Frege and, subsequently, David Hilbert, mathematics came to be understood largely in terms of formal systems and symbolic representations. This approach afforded unprecedented precision and rigor, making it possible to systematically construct complex concepts and resolve fundamental problems. However, it also gave rise to a tendency to move away from the question of meaning, focusing instead on the internal consistency and formal structure of these logical systems[2].

In this context, formalism arose as a significant and impactful stance, asserting that mathematics is essentially a game conducted with symbols governed by established rules. This idea gives a clear and methodologically sound picture of how math is done, but it also brings up deep philosophical questions. The primary concern is the emergence of meaning within a strictly formal system. If symbols are regarded as lacking inherent significance, the comprehensibility of mathematical discourse becomes challenging to elucidate.

Critics have said that the danger is that math becomes a mechanical process that doesn't have any real cognitive content[3]. This tension is what drives this investigation. This study employs a phenomenological approach, drawing on the work of Edmund Husserl, to reclaim the aspect of meaning overlooked by formalism.

Phenomenology does not dismiss the accomplishments of formalization; instead, it contextualizes them within a comprehensive examination of the structures of consciousness that generate meaning. From this viewpoint, mathematical

[1] Republic, trans. G. M. A. Grube (Indianapolis: Hackett, 1992), 508d–509b; Critique of Pure Reason, trans. Paul Guyer and Allen Wood (Cambridge: Cambridge University Press, 1998), A20–A25/B34–B39.
[2] The Foundations of Arithmetic, trans. J. L. Austin (Evanston: Northwestern University Press, 1980), §§62–69
[3]The Foundations of Arithmetic, trans. J. L. Austin (Evanston: Northwestern University Press, 1980), §§62–69.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

objects are perceived as ideal entities manifested through intentional consciousness, possessing a mode of existence that is neither empirical nor merely symbolic[1].

Another main premise of this work is the notion that mathematical meaning involves three components - namely forms, symbols, and words. Forms stand for the ideal content of mathematical discourse; symbols represent the formal manipulation of this content; words give expression and communicability to mathematical meanings. Such triadic nature of mathematical intelligibility cannot be reduced to any of the three aspects alone, for none of them alone could ever explain why mathematics makes sense.

What is more important in terms of this approach to mathematics is that it does not just challenge the premises of formalism. It can make an important contribution to our understanding of rationality, objectivity, and knowledge itself. Mathematics turns out to be more than a science; it becomes something like a privileged field where the very structures of meaning show up in full display. In this way, one can see how important it is to explore the phenomenology of mathematics.

This paper will focus on the analysis of formalism and its implications for mathematics, and the construction of a framework of phenomenology of mathematics. In this way, it seeks to prove that the basis of mathematics does not consist of formal systems only, but also in the constitutive process of consciousness, enabling one to have experiences of intelligibility.

The Formalist Program

A further development of the formalist project demands that we contextualize it historically and foundationally, especially in connection to the crises that struck mathematics around the turn of the century. The appearance of paradoxes of set theory, like Russell's paradox, raised serious doubts about the possibility of a consistent formal mathematical theory, thus requiring the discovery of a safe and sound ground for it. In these conditions, David Hilbert developed the program of formalism which sought to ensure the completeness and consistency of mathematics by means of finitism[2]. The idea was not merely practical but also philosophically motivated, namely, to show that all of mathematics can be derived from a few axioms using certain rules of inference, and that the resulting system can be proved to be consistent.

The core of the formalist approach is the dichotomy between syntax and semantics and its prioritization of the former as the legitimate realm for mathematics. Mathematics is viewed in terms of symbol manipulation, whose correctness is defined only by its possibility of derivation from a formal language. Such an orientation ensures a very high level of clarity since it does not allow for ambiguity and subjective interpretation. On the other hand, it presupposes that any consideration of issues of meaning is voluntarily suspended and placed outside philosophy. It might thus be said that the formalist approach seeks to make of mathematics a complete calculus.

However, the success of this strategy only goes to demonstrate the flaws in such a strategy. Formalism is premised on the idea of evidence and clarity, which can neither be formalized nor defined in terms of formal rules. For instance, the acceptance of certain axioms depends upon the fact that these axioms are evident or pragmatic enough to justify the formal process[3]. The problem with formalism is that there will always be some intuitive aspect to the process that cannot be eliminated. The study of metamathematics involves a level of introspection not found in any formal system.

Nevertheless, it was Kurt Gödel's incompleteness theorems that put an end to the project of the formalist program once and for all by proving that any sufficiently complex formal system is necessarily incomplete or contradictory[4]. In other words, the very concept of the completeness and finitistic provability of all mathematics has been shown to be impossible to achieve from within the framework of the formalist program. Furthermore, Gödel's findings imply that mathematical truth cannot be fully grasped through formal derivations, thus raising the issue of meaning and mathematical truth anew.

As far as philosophy of mathematics is concerned, one can conclude that formalism is a highly useful and important methodology yet not an answer to the fundamental problem of mathematics as such. Formalism's emphasis on symbolic structures brings greater rigor to mathematical thought but does not explain what meaning lies behind the formal expressions and why they matter for us. The formalist program, then, represents an important part of the history of thought but not an ultimate solution to the philosophical problem of mathematics.

The Problem of Meaning

Another aspect of the problem of meaning can be seen in the difference between sense (Sinn) and reference (Bedeutung), which was originally brought out in a seminal paper by Gottlob Frege. Whereas formalism usually places emphasis on the latter, since it deals with the truth values produced in a formal system, it tends to ignore the former, which is the method of presentation by means of which the object itself becomes intelligible. In mathematics, this is especially important because the same reference value might be reached through different symbolic or conceptual paths, each of which carries

[1] What Is Mathematics, Really? (Oxford: Oxford University Press, 1991), 112–118.
[2] Foundations of Geometry, trans. E. J. Townsend (Chicago: Open Court, 1902), 1–10.
[3] Formal and Transcendental Logic, trans. D. Cairns (The Hague: Nijhoff, 1969), 32–38.
[4] On Formally Undecidable Propositions of Principia Mathematica and Related Systems, trans. B. Meltzer (New York: Dover, 1992), 35–41.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

its own cognitive import. The formalist approach to mathematics thus entails a serious risk of overlooking this aspect of meaning[1].
The problem of meaning becomes even more acute when one takes into account the issue of symbolic opacity, that is, the possibility of manipulating symbols without knowing the cognitive significance behind them.
That being said, this lack of transparency does not render the findings obtained through such formal reasoning meaningless, but poses crucial philosophical questions on the very essence of understanding. For instance, is there an understanding of a proposition if one can produce a mathematical argument that proves its validity? Here, there appears a gap between the ability to prove something and understanding what is proven, one that cannot be bridged by means of formal arguments alone [2].
The issue of meaning points to another aspect of mathematical understanding which cannot be solved from within a formalist approach to the subject. Namely, the problem of meaning presupposes that there is always a pre-predicative level at which objects of our judgment appear in their meaningfulness to us, prior to any symbolic or linguistic articulation of this meaning. Edmund Husserl writes that all judgments have a predicative and an intuitive level of intentionality and the latter is always foundational to the former since the meaning of an object only arises through its immediate experience by consciousness[3]. In other words, it is impossible to derive meaning artificially using formal rules; meaning is always present as a primordial element of consciousness.

Phenomenological Framework
A deeper exploration of the phenomenological framework demands attention to the methodological role of the epoché and the phenomenological reduction. Through these, we set aside our usual, everyday assumptions in order to uncover the structures of pure consciousness.
By bracketing the belief that mathematical objects exist independently out there, the analysis doesn't deny their objectivity. Instead, it shifts attention to how these objects actually appear to us and how they are given in experience. This shift makes it clearer how mathematical entities come to be understood as ideal units, grasped through intentional acts of consciousness rather than through empirical observation. As Edmund Husserl emphasizes, this process of reduction reveals a level of transcendental subjectivity where meaning is not simply received, but actively formed[4].
In this context, intentionality is conceived of as the very basic structure of consciousness wherein all acts are directed at some object insofar as it means something. Therefore, mathematical thought should not be understood as some detached abstraction, but rather as an intentional act involving some kind of clarification of an ideal object. It is especially important to distinguish between the concepts of noesis, as the act itself, and noema, as an object intended by such act, since this distinction makes it possible to consider different ways of representing the same mathematical form.[5].
Moreover, one needs to stress the role played by horizonality in the constitution of mathematical meaning. Every act of comprehending any phenomenon is framed by certain horizons of possibilities, both limiting and directing such comprehension. In mathematics, such horizon includes everything known before, including some symbolic system used to express ideas, as well as language itself.3 Such an approach allows seeing that mathematical meaning is inherently connected with other relations and anticipations
As a result, the phenomenological approach offers a strong alternative to reductionist explanations by showing that mathematical meaning arises from the interplay between conscious acts and ideal structures.
It suggests that the foundations of mathematics are not found only in external objects or formal systems, but are rooted in the basic activity of consciousness itself, an activity that makes understanding possible in the first place.

Forms as the Ground of Meaning
Clarification of forms as a source of meanings, another important method in phenomenological analysis, could be provided through the consideration of forms' role in eidetic variation. The idea here is to imagine possible variations of a certain object and to see which features of it remain essential and constant through those alterations. It becomes clear when applying this method to mathematical objects that the essence of mathematical forms consists in a definite set of structural relations and does not involve their empirical realization. A triangle could appear in different shapes or oriented differently or drawn in different media; however, its form would remain intact. This shows that forms are not some abstract notions

[1] On Sense and Reference, in *Translations from the Philosophical Writings of Gottlob Frege*, ed. Peter Geach and Max Black (Oxford: Blackwell, 1952), 56–78.
[2] What Is Mathematics, Really? (Oxford: Oxford University Press, 1991), 89–95.
[3] Experience and Judgment, trans. J. S. Churchill and K. Ameriks (Evanston: Northwestern University Press, 1973), 21–27.
[4] Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy, trans. F. Kersten (The Hague: Nijhoff, 1983), §§31–33.
[5] Logical Investigations, vol. 2, trans. J. N. Findlay (London: Routledge, 2001), §§90–94.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

we abstract from experience, but the conditions under which the correct recognition of an object in its proper form is possible. As argued by Edmund Husserl, all such essences are revealed in eidetic intuitions and are found in the universal[1]. Finally, the normative function of mathematical forms needs to be mentioned. Forms are the very standards according to which judgments about mathematical objects should be recognized as either true or false, regardless of individual opinions or experiences. This necessity cannot be fully elucidated solely by formal systems, for it arises from the internal structure of the forms themselves, rather than from externally imposed rules[2].
Moreover, the importance of the grounding nature of forms becomes all the more apparent when one thinks about the potential for making mistakes in the course of mathematical reasoning. Mistakes are not made due to the inherent ambiguity of forms but rather due to the inadequacies of the linguistic or symbolic expression of their nature. The awareness of mistakes necessarily implies a prior acquaintance with the right form against which the mistake can be compared[3].
As such, forms must be viewed not only as stable and unchanging but also as living intelligible structures which are progressively unfolded by acts of consciousness.

Symbols as Mediators

Another side of symbolic mediation shows up in how symbols make general reasoning in mathematics possible. By stepping away from particular cases, symbols allow mathematicians to work with structures independently of any specific content, which opens the door to universal application. For instance, algebraic notation lets us deal with relationships in their pure form, without being tied down by empirical or intuitive limits. Still, this kind of generality doesn’t mean symbols are empty of meaning; it simply means that the ideal structures they point to remain stable across different contexts. As Edmund Husserl puts it, symbolic representation always rests on acts of meaning that give life to otherwise empty signs[4].
At the same time, symbols don’t just represent, they also produce. Through symbolic manipulation, mathematicians can uncover new relationships and structures that weren’t directly present in the original intuition. This becomes especially clear in more advanced mathematics, where formal operations lead to results that need further interpretation and conceptual understanding. But this creative power isn’t independent. What looks like the “productivity” of symbols actually depends on the background of meaning they are rooted in; without that, their operations wouldn’t make sense at all[5].
Also, the mediating role of symbols becomes particularly significant within the context of cognitive economy and precision. Symbols condense complex relationships into manageable forms, thereby enabling the efficient execution of reasoning processes that would otherwise be cumbersome or impossible. This condensation enhances both the clarity and the rigor of mathematical thought, yet it also introduces the risk of reification, whereby symbols are treated as if they possess an intrinsic meaning, independent of the acts that constitute them. Such a tendency reinforces the formalist illusion that mathematics is self-sufficient as a symbolic system.[6].
From a phenomenological perspective, these considerations underscore that symbols function as indispensable yet derivative mediators. They do not generate meaning, nor do they exist independently of it; rather, they serve as the bridge between ideal forms and their articulation in thought and language. To understand symbols in isolation is, therefore, to misinterpret their role within the broader structure of mathematical intelligibility.

Words and Linguistic Articulation

An additional aspect of linguistic articulation emerges if one considers the importance of clarifying concepts in mathematical language. Not only do words follow symbol manipulation but they help define the horizon of meaning against which symbol manipulation takes place. Definition, for example, serves as an act of demarcation that provides clarity by fixing the meaning of words. In absence of such clarity, the ambiguity associated with symbols would make mathematical reasoning meaningless. As Edmund Husserl explains, the transition from vague perception to sharp conception is possible through linguistic articulation alone[7].
Language also plays a key role in how mathematical knowledge is justified and communicated. A proof isn’t just a chain of symbolic steps; it’s part of a broader way of explaining why each step works and how it contributes to the overall argument. This explanatory layer involves understanding, insight, and conceptual clarity, so it can’t be reduced to formal

---

[1] Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy, trans. F. Kersten (The Hague: Nijhoff, 1983), §§3–5.
[2] Cartesian Meditations, trans. D. Cairns (The Hague: Nijhoff, 1960), 27–32.
[3] The Crisis of European Sciences and Transcendental Phenomenology, trans. D. Carr (Evanston: Northwestern University Press, 1970), 44–49.
[4] Logical Investigations, vol. 2, trans. J. N. Findlay (London: Routledge, 2001), §§20–24.

[5] Formal and Transcendental Logic, trans. D. Cairns (The Hague: Nijhoff, 1969), 78–85.
[6] Introduction to Mathematical Philosophy (London: Allen & Unwin, 1919), 65–70.
[7] Logical Investigations, vol. 1, trans. J. N. Findlay (London: Routledge, 2001), §§7–9.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

symbols alone. As Ludwig Wittgenstein points out, meaning comes from how expressions are used within particular practices, and mathematical language gets its significance from the contexts in which it operates[1].

At the same time, language makes reflection in mathematics possible. It allows mathematicians to step back from the symbols they are working with and think about the structures behind them. This ability to reflect is essential for developing new theories, since it opens the door to questioning and reshaping existing ideas. In this sense, language is not just a way to express mathematics, it's also a tool for critical thinking, helping mathematical meaning evolve over time[2].

In phenomenology, it is clear that such questions prove words to be part of the three-part system that makes up mathematics and are not separate from the process. They are what make mathematics meaningful and communicable because they act as mediators between intuition and abstraction.

Triadic Constitution of Meaning

There are three very important triadic structures. They are form, symbol, and language. If we look more closely at this threefold structure, it becomes clear that their relationship isn't just linear or one-way. It's recursive and mutually shaping. Ideal forms ground symbolic representation, and symbols make linguistic expression possible, but the movement also goes in the opposite direction. Clarifying something in language can lead to a fresh grasp of the underlying form, and working symbolically can bring out structures that weren't initially given in intuition. This circular movement doesn't weaken the primacy of form; rather, it shows the three as dynamically interconnected, working together in the ongoing formation of meaning[3].

This three-part model also helps explain both the stability and the development of mathematical concepts over time. Ideal forms provide continuity, ensuring that mathematical objects remain identifiable even as notation and terminology change. At the same time, symbols and language open the door to innovation. They allow mathematicians to extend, refine, and sometimes reshape the field of meaning in which these forms appear. For example, the rise of symbolic algebra didn't create entirely new mathematical realities out of nothing; instead, it reorganized how already-constituted ideal relations could be accessed, expressed, and worked with more effectively[4].

This point of view also helps in understanding how embodiment and temporality contribute to mathematical meaning. Understanding takes place over time via successive stages of symbolic and linguistic mediations. Every operation carried out in a mathematical demonstration, every step taken within a proof, as well as any further explanations that may be provided to clarify symbolic manipulations, add their contributions to the development of a particular meaning. In other words, the triadic structure should be viewed not as some sort of abstract pattern but rather as an experiential process[5].

Thus, the triadic structure offers a broader picture of mathematical meaning than could be obtained in any reductionist approach. Indeed, the triad is such that mathematical meaning can no longer be reduced to any of its aspects. Meaningful understanding cannot occur if any single aspect is disregarded. Instead, the three moments must come together to form the totality of mathematical understanding.

Critical Evaluation of Formalism

A further difficulty within formalism emerges when one considers the problem An additional problem for formalism occurs in the context of intersubjective validity, which, in fact, is one of the core aspects of mathematical practice. It would be wrong to think of mathematics only as a subjective manipulation with signs since mathematics is actually a shared experience, an objective process, which is supposed to be equally true regardless of the subject or the context it takes place in. Unfortunately, formalism provides no solution to the problem of universality in mathematics. If we were to assume that mathematics is just the manipulation with signs following certain rules, then what would be the reason for various subjects to agree on the semantics of these signs? One cannot reduce the universality and objectivity of mathematics simply to syntactical consistency because the latter already assumes a previous comprehension of its semantics. Edmund Husserl stated that the ideality of mathematical objects can be found exactly in the reproducibility of their identity through all possible kinds of consciousness[6].

In addition, formalism fails to take into consideration the normative element in mathematics. Mathematical discourse is not only regulated by formal rules but also guided by such criteria as rigor, elegance, and explanatory force. Such norms, however, cannot be established on the basis of formalisms since formalisms can merely define what kinds of operations are valid but not how important or valuable they are. The difference between a meaningless operation and an insightful one cannot thus be explained by syntactical considerations alone. Gödel's theorems on incompleteness indicate that

[1] Philosophical Investigations (Oxford: Blackwell, 1953), §§23–27.

[2] Remarks on the Foundations of Mathematics, ed. G. H. von Wright et al. (Cambridge, MA: MIT Press, 1978), 15–18.

[3] Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy, trans. F. Kersten (The Hague: Nijhoff, 1983), §§84–88.

[4] The World of Mathematics, ed. James R. Newman (New York: Simon & Schuster, 1956), 214–220.

[5] Phenomenology of Internal Time-Consciousness, trans. J. S. Churchill (Bloomington: Indiana University Press, 1964), 47–53.

[6] Logical Investigations, vol. 2, trans. J. N. Findlay (London: Routledge, 2001), §§31–33.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

sufficiently strong formal systems are unable to capture all the truths that can be stated by them; consequently, truth outruns formal provability[1].Thus, formalism is not only shown to be false to its basic presuppositions, but the inadequacy of its position leads us to the realm of the meaningful as well.
Indeed, the history of the discipline itself poses a challenge to such an approach. For example, non-Euclidean geometries did not originate through mere extensions of formal axiomatic systems, but through a conceptual and intuitive breakthrough. While formalism concentrates on symbolic systems, it thus neglects the productive and creative potential of mathematics.
Phenomenologically, then, formalism can be seen as merely capturing one level of meaning in the discipline. Indeed, formal symbols and rules must always be embedded in a larger field of meaning, which is generated through intentional acts of consciousness. Without the larger field of meaning, formalism could not orient itself towards any end nor possess meaningful content. It would amount to mere symbolic calculation without any cognitive content whatsoever. This critique of formalism is thus not intended to reject the theory, but rather to embed it into a larger theory of meaning and place ideal structures into a primary position.

Conclusion

A further implication of this analysis concerns the future orientation of the philosophy of mathematics, particularly in light of current developments in the fields of logic, computation, and cognitive science. While formal systems continue to expand in scope and sophistication, the phenomenological critique advanced in this study suggests that such developments must be accompanied by a renewed focus on the conditions of meaning and understanding. Without this complementary perspective, there is a risk that mathematics will increasingly come to be viewed as a purely technical enterprise, detached from the lived experience of intelligibility that endows it with significance in the first place.
Moreover, the triadic structure of forms, symbols, and words are all grounded in the horizon of Abstralon and opens up new possibilities for interdisciplinary engagement. It provides a conceptual bridge connecting mathematics, philosophy, linguistics, and even artificial intelligence, where questions of symbolic processing and semantic grounding remain central. By emphasizing the constitutive role of consciousness, this approach challenges reductionist models that seek to explain cognition solely in terms of formal operations, highlighting instead the irreducible dimension of meaning that underpins all symbolic activity.
Finally, this study underscores that the critique of formalism is not an attempt to diminish its importance, but rather to situate it within a more comprehensive philosophical account. Formalism remains an indispensable methodological tool; however, its limitations reveal the need for a deeper inquiry into the origins and structures of meaning. The phenomenological perspective, by illuminating the interplay between the ideal, the symbolic, and linguistic articulation, offers precisely such an account. It demonstrates that mathematics is not merely a system of rules, but a living expression of rationality in which the structures of thought and being converge. In this sense, the ultimate significance of the present study lies in its attempt to validate mathematics as a domain in which the unity of meaning and intelligibility becomes most explicitly manifest, thereby offering further reflections on the fundamental nature of human understanding.

References:

1. Benacerraf, Paul, and Hilary Putnam, editors. *Philosophy of Mathematics: Selected Readings*. Cambridge UP, 1983.
2. Carnap, Rudolf. *The Logical Structure of the World*. Translated by Rolf A. George, University of California Press, 1967.
3. Davis, Philip J., and Reuben Hersh. *What Is Mathematics, Really?* Oxford UP, 1991.
4. Descartes, René. *Rules for the Direction of the Mind*. Translated by John Cottingham et al., Cambridge UP, 1985.
5. Dummett, Michael. *Frege: Philosophy of Mathematics*. Harvard UP, 1991.
6. Frege, Gottlob. *The Foundations of Arithmetic*. Translated by J. L. Austin, Northwestern UP, 1980.
7. ---. “On Sense and Reference.” *Translations from the Philosophical Writings of Gottlob Frege*, edited by Peter Geach and Max Black, Blackwell, 1952, pp. 56–78.
8. Gödel, Kurt. *On Formally Undecidable Propositions of Principia Mathematica and Related Systems*. Translated by B. Meltzer, Dover, 1992.
9. Hilbert, David. *Foundations of Geometry*. Translated by E. J. Townsend, Open Court, 1902.
10. Husserl, Edmund. *Cartesian Meditations*. Translated by D. Cairns, Nijhoff, 1960.
11. ---. *Experience and Judgment*. Translated by J. S. Churchill and K. Ameriks, Northwestern UP, 1973.
12. ---. *Formal and Transcendental Logic*. Translated by D. Cairns, Nijhoff, 1969.
13. ---. *Ideas Pertaining to a Pure Phenomenology and to a Phenomenological Philosophy*. Translated by F. Kersten, Nijhoff, 1983.
14. ---. *Logical Investigations*. Vols. 1–2, translated by J. N. Findlay, Routledge, 2001.

[1] On Formally Undecidable Propositions of Principia Mathematica and Related Systems, trans. B. Meltzer (New York: Dover, 1992), 38–40.

REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 25, No. 1s (2024)
http://www.veterinaria.org
Article Received: Revised: Accepted:

15. ---. *Phenomenology of Internal Time-Consciousness*. Translated by J. S. Churchill, Indiana UP, 1964.
16. ---. *The Crisis of European Sciences and Transcendental Phenomenology*. Translated by D. Carr, Northwestern UP, 1970.
17. Kant, Immanuel. *Critique of Pure Reason*. Translated by Paul Guyer and Allen Wood, Cambridge UP, 1998.
18. Newman, James R., editor. *The World of Mathematics*. Simon & Schuster, 1956.
19. Plato. *Republic*. Translated by G. M. A. Grube, Hackett, 1992.
20. Quine, W. V. O. *Word and Object*. MIT Press, 1960.
21. Russell, Bertrand. *Introduction to Mathematical Philosophy*. Allen & Unwin, 1919.
22. Weyl, Hermann. *Philosophy of Mathematics and Natural Science*. Princeton UP, 1949.
23. Wittgenstein, Ludwig. *Philosophical Investigations*. Blackwell, 1953.
24. ---. *Remarks on the Foundations of Mathematics*. Edited by G. H. von Wright et al., MIT Press, 1978.