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Transcendental Method in Philosophy as the Foundation of Scientific, Mathematical, Theological and Historical Methods of Study

By

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One of the unavoidable facts about knowledge in whichever discipline you may look at it from is that it is not automatic. It is not a mere opening of the eyes but a pain staking journey. The journey involved in the process of learning and knowing revolves around three things, that is, truth, criterion and objectivity. While this sound an overstatement, this fact ubiquitously presents itself in the minds of all scholars. Philosophers, natural and social scientists, historian and humanist, mathematician and logician, have continually preoccupied themselves with the above fact in attempting to clarify these three concerns which squarely lie in realm of epistemology. However, the answers yielded have been disparate, conflicting and confusing. This present paper will attempt to lay bare some of the concerns about criterion. By criterion is meant the methodology adapted in any study. The argument that this paper makes is that all areas of study, be it philosophy, science, mathematics, history, economics remotely use a particular pattern of relation and cognitional activities which are similar. This pattern of relation is summed up by transcendental method which consists of involving a moment of experience, understanding and judgment. This paper therefore will show that there is fundamentally one method for any genuine knowledge and this is the transcendental method. Secondly the paper will demonstrate that there is no difference in method, procedures and process in philosophy and other disciplines shown above. This will be followed by an extensive and elaborate exposition of how transcendental method actually fits in all disciplines of studies and how this foundational method is critical in helping to clear the questions of the methodology which has been hyperbolized in the myriad of confusion created by scholars in those disciplines.

Key words: Transcendental, scientific, mathematical, theological, and historical methods

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Introduction

The major concern of philosophy is to establish the principles, criteria, methods and ground by which proper knowing can be attained. It is a belief that through proper knowledge, man can be able to control and manage the world of proportionate being. This means that it is philosophy that knowledge as a discipline with a view of establishing the correct assumption upon when knowledge can be built. Ideally, philosophy is the widest discipline because it underpins all areas of study by determining the province and the jurisdiction of each of them. The content of each of these disciplines may be different yet the method of study must involve some stages or levels which are immanent, identical universal and un-revisable. This mean therefore, that regardless of discipline of study, the method of study remain that which is discoverable by philosophy.

This article therefore will show that there is fundamentally one method for any genuine knowledge and this is the transcendental method. This present article will attempt to lay bare some of the concerns about criterion of study adopted in each discipline. It will establish the similarity that exists in terms of methodology among various disciplines. Transcendental method which reveals itself in three levels of experience, understanding and judgment will be unfolded as fundamental in all human knowing. Secondly, it is the focus of this article to unfold how this method underpins all areas of studies including; natural and social sciences, mathematics, theology and history. Lastly the article will demonstrate cognitive activities which coalesce in every level of knowing starting from experience, understanding and finally judgment. Finally, a critical appraisal will be made on this topic of discussion before concluding.

1.1 Contextual analysis

The discussion about the criterion or method of study of any discipline is not only critical but also crucial. This is true in the sense that if one is not clear on the method that is being used in studying a particular discipline, then, it would seem impossible to identify when the true and certain knowledge has been attained about that particular discipline. Similarly, no one can comfortably align, connect and relate to other areas of study, in a proper sense, if he has not identified the methodology and criteria used in his area so as to appropriately compare and contract its knowledge. This in a sense points to a very strong and fundamental supposition that universality of knowledge is not on the content as such, but on the criteria, method, process and procedure used for in its attainment.

In other words, the facts about a given reality can only be attained in a proper and legitimate sense when a right method and procedure has been used and applied unequivocally to the aspect under study and when its outcome has been verified as true legitimate knowledge. The above concern mirrors the confusion that has existed in the relationship among philosopher, natural and social scientists, anthropologists and historian, logician and mathematician. The bone of contention has been largely on the issue of differences in the methodology and procedure used in their respective discipline. In examining the situation as regard our discussion about criterion of study, we can here state that knowledge of anything is as the result of the combination of factors which are both external in the object and internal in the subject.

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As a matter of emphasis, our present concern is on how and not what. This puts our concern squarely on how the subject consciously cognize and integrate the activities of knowing in understanding the world of proportionate being which is either natural, biological, physical, social, moral, psychological or political in nature. In this sense, therefore, knowledge is thought to be the central core in all human beings. This fact has remained unopposed because it supports the supposition that man has always possessed intellect and rationality that makes him to be unsatisfied and restless till he finds secure and firm knowledge (Glock, H., Aristotle Anthropology, 2019:140-160). This does not matter what field or discipline of study he is engaged in. While this is undeniable, the philosophical concern of method involved comes intrinsically with this acceptance. Ideally speaking, philosophy is the foundation of all areas of study. This being the case, philosophy underpins all areas of studies in such a way that it provides the principles and parameter which guide the operation of all other discipline.

One of the most fundamental things that philosophy adds is the principles which guide the human thinking and reasoning. The logical principles upon which all knowledge is realizable and possible is taught and provided by philosophy. This suggests that the issue of the most appropriate method to be used in any discipline is known to philosopher prior and a priori before it is put in practice by scholars in relevant disciplines. Philosophy, in essence sets the critical spirit of inquiry of all discipline.

In addition to the above discussion, Epistemology has remained a very important discipline in clarifying critical and crucial aspects concerning knowledge. Among the most fundamental concerns of epistemology is the what, the how and the why of that which we call knowledge. It seeks to clarify what knowledge is, how it is acquired (criterion) and finally why such process leads to knowledge (objectivity). In this endeavor the concern of method is first a problem to philosophers and secondarily a problem of all other scholar who are primarily interested with knowledge creation and consumption.

1.2 Statement of the Problem

There is a disparaging and unfounded claim that knowledge attained in various discipline is uniquely differently and univocal in such a way that it has nothing to do with other disciplines. While this claim is strongly anchored in the belief that the content attained is essentially different and therefore the methods used must as well be unrelated altogether. This has caused a major confusion in the relationship among philosopher, natural and social scientists, anthropologists and historian, logician and mathematician. The bone of contention has been largely on the issue of differences in the methodology and procedure used in their respective discipline. The argument that this article makes is that all areas of study, be it philosophy, science, mathematics, theology and history remotely use a particular pattern of relation and cognitional activities which are similar. These activities are put together by a transcendental method.

2.0 Method and Criterion of various discipline

Several times we are faced with the question of criterion of study. This concern is about the methods, the regulations, the procedure and the directives that are supposed to be followed in the study of any discipline. Remotely, man is a being that is endowed with the intellect. When his intellect is at work, intellection takes place and gives rise to a product or object, that is, what the intellect has abstracted from the reality which is thought to be outside. With this in mind there are several perspectives and questions that arise. For instance, is the criterion going to be the same for every study and discipline? Or is the criterion different? If it is different, what is the relationship between knowledge gotten through criterion A from that gotten through criterion B? How do the facts and truths from different areas with different criterion inform the world of proportionate

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being? This article will analyze the criterion and methods involved in philosophy, natural and social sciences, mathematics and logic and history with a view of identifying what similarities if any that can be found and what would be the noticeable differences.

2.1 Philosophy – Transcendental Method as a Criterion

For the purpose of coherence in this discussion, it is worthwhile to start by asking ourselves, what is transcendental philosophy and transcendental method? The term transcendental philosophy means the kind of philosophy which refers to the activity of the self (me and you) as a knowing subject seeking itself through personal appropriation of one's own rational self-consciousness. It involves understanding the whole process of knowing, that is, experience, understanding and judgment and finally moral judgment of our actions.

Transcendental method is closely related to transcendental philosophy in that they intrinsically depend on each other. It is what flows from the intrinsic dynamism of the human knowing. This method of transcendence requires the heightening of one's self-consciousness or awareness. This is done by applying one's cognitional activities to four epistemological precepts. These precepts are: Be attentive, be intelligent, be reasonable, and Be responsible. To be attentive means to be familiar and conscious of the experience both external and internal. Without being attentive, one cannot be able to acquire the necessary data for possible understanding.

To be intelligent is to be open minded so that one can be able to understand properly without being biased. This requires one to formulate, suppose and make further and inclusive inquiry into the matter being brainstormed. To be reasonable is simply to be critical to what you understand. This process of knowing is intends something to be known which is technically called 'object'. However, knowing in a proper sense is knowing being. This being can be in form of all that concerns man about himself, world and God. This puts our topic of discussion squarely in this because we are interested with the method of study of natural sciences (physics, chemistry and biology), mathematics, philosophy, history and other humanities.

Fundamentally, transcendental method is involved in the threefold structure of cognition that is, experience, understanding and judgment. Through questions one transcends from one level to the other. According to Lonergan, transcendental method is grounded on the exercise of self-appropriation. In so far as one has successful undergone the process of self-appropriation which comes as a result of interiority, this method spontaneously emerges, comes to the surface with the unique thrust to guide the process of knowing towards the attainment of the knowledge of being. These norms are immanent in the cognitional process. Thus, transcendental method guides all the process of knowing starting from the experience and representation, to insight and hypothesis, further to reflection and judgment regardless of the discipline one is engaged in. It guides this process by supplying the transcendental imperatives or precepts, which brings the subject to the attainment of the goal. In essence, what we are saying is that self-appropriation is the ground of all method, transcendental method is has been found to be the one that encompasses all disciplines. In *Method in Theology*, Lonergan insists, "For self-appropriation is a grasp of transcendental method, and that grasp provides one with the tool not only for an analysis of common sense procedures, but also for the differentiation of the sciences and the construction of their method." (Lonergan, *Method in Theology*, 1967:83)

Transcendental method leads to development in all areas of studies because it works on the principle of going beyond the known to the unknown. Man is never content with what he knows. Every moment he is pushing for what is known as unknown. Hence, man is in a constant search for new insights, which complement those already attained in the higher levels of integration. Thus, successful viewpoints emerge till a higher viewpoint is reached. In this transcendence, knowledge develops further and further to include everything that is

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knowable in the universe of proportionate being. Therefore, in his act of immanent transcendence, the transcendental method enables one to reach firm and correct intellectual development.

Thus, with the conscious possession of the transcendental method, the self-appropriating subject is no longer confined within his own subjectivity, but is effectively placed in the larger world of subject for a creative, collaborative and methodical search for truth in all areas and in all disciplines. I could say that transcendental method, is a critical method for all knowledge seekers. It is a critical method in the sense that it is a method in respect to the ultimately most basic issues. This method differs with the other method only in its subject-matter.

Moreover, the subject himself makes this discovery and he cannot continue in this situation. He has to question his account starting from the beginning this is what happens in scientific innovations and inventions which has propelled science to the greater heights. In order to discover where the problem lies, he has to do research about this account. Sooner or later he discovers that he has to gather data from his own experience, then make an inquiry over them, this will lead to a formulation of possible answers. But he is compelled to move to the critical level, which will gather evidence and weigh them so as to pass a reasonable affirmation of actual true account, the real account. This process of rethinking one's position is a reversal and once a counter position has been reversed, one's horizon develops, his knowledge improves and his personal development is enhanced (Lonergan, *Insight* 1957:418)

And such is the development of understanding which is attainable not only in philosophy, but also in Logic, mathematics, science, common sense, and others according to the differences in the route of the circle. Ideally speaking, this is how human understanding develops in various fields of knowledge. Thus, according to the principle of emergence, there are the accumulating insights, which are higher integration of otherwise coincidental manifolds of images or of data. Further, according to the principle of correspondence different data require different understanding and formulation. All these processes depend on the basic motor or operator of this unfolding of intellectual development that is, the pure, detached, disinterested, and unrestricted desire to know in its dynamic operation.

In addition, the search for truth presupposes the search for authentic position. It involves creative collaboration and mutual openness. Therefore, every personal attempt at knowledge is facilitated and enriched by the experience, understanding and judgment of the community in which one lives. We identified in this article the real fundamental role-played by the self-correcting process of learning. The above can be summarized in the following table.

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Table 1: Self-correcting Process of Learning

3rd level of Rational Consciousness	Reasonable 'Thing'	Verification Judgment	Reasonableness Rational
2nd level of intelligent consciousness	Intelligible ideas World mediated by thought	Definition Understanding	Intelligibility Intelligent
1st level Empirical Consciousness	'Body' Already out there now real	Looking Imagination	Extroversion

2.2 Natural and Empirical Sciences

Natural sciences are those sciences that are engaged in the study of physical, chemical and biological objects or phenomena. They are the sciences which deal with establishing the theories, laws, explanations and causes of physical, chemical and biological realities. These realities are limited to the world and man for science doesn't have any role in the study of God. Science started right from the ancient period when we realize the first question being wrestled by Thales, Anaximander and Anaximenes to be a question related to the physical reality, that is, matter. These ancient cosmologists wanted to find out the material through which the universe has been made. They were interested with the physics, the biology and the chemistry of the world where they lived. Democritus, an ancient philosopher who had a strong inclination to sciences, came up with atomic theory of the universe. He taught that there are smallest and indivisible bodies from which everything is made or composed of. This theory brought to rest Parmenides refutation that in order to have change something must come from nothing to being which was impossible.

Democritus demonstrated that the small indivisible particles have the tendency to persist and rearrange themselves into another object which was different from the previous one. While this was an outstanding discovery, there is no indication of how Democritus reached at this assertion. Basing ourselves from his proponents like Leucippus, Anaxagoras, and Empedocles, the great pre-Socratic philosopher didn't know that they were answering a scientific question using philosophy. They thought that they were philosophizing using first principles of philosophy and logic. The method used here is that of philosophy where by deductions were made from all manner of philosophical positions.

Perhaps with Aristotle, science became more pronounced and experiential. He made science integral, coextensive and ubiquitously similar to philosophy. In his *Physics* Aristotle held that science (episteme, scientiae had a broad meaning which included all courses which sought to find out why. Any course which attempted to find out the causes, the why and the proximate reason for any reality was regarded as science. Science was logical and systematic. It was a product of a long observation and experience of the world and nature as a whole. The causes and the invariant patterns that such occurrences took was of great concern to Aristotle. According to him, natural sciences belong to the division of science called the theoretical sciences. These are the sciences which are sought for the sake of knowledge. They are the scientific investigation whose aim is to understand and appreciate nature as it is. They include biology, botany, zoology, physics, astronomy, chemistry and archeology. What is perhaps unique is that Aristotle depended on philosophy to understand science. He used first principles discovered by philosophy to study science. Due to this, he involved deduction, that is, thinking from the general principles to the

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particular instances. Any course that proceeded by deduction was regarded as science. This extended to mathematics, metaphysics, theodicy and even ethics and politics. Aristotle in (APO. 72b32-73a6) sought to clarify that all knowledge requires demonstration and all demonstration proceeds from what is more intelligible by nature to what is less so, this process only stops when one reaches what cannot be demonstrated using any other. When such explanation is reached, it is deemed secure and known well. This is what Aristotle regarded as first principles, and it is what in his reasoning can be regarded as science.

The above explanation about science gives us a strong and clear view of how science was perceived in the ancient times and lays a beacon for understanding the scope and province of science. While his teaching on science may not stand at the moment, his understanding helps us to see the origin and the struggle that science has undergone. From Aristotle teaching we gather two aspects. First, that he preferred to use deduction as a method in the process of acquiring knowledge about nature. This involved a mastery of the first principles from where all knowledge could be demonstrated and understood from. Secondly, in this process we realize a procedure where judgment or principles are used as a tool to acquire knowledge of the world. We see in Aristotle's teaching very important epistemology where there is an object to be known, the principles which guide the process of knowing, and lastly, we identify the use of logic in moving from the general to the particular. The process of grasping and educing knowledge which involved identifying, distinguishing and differentiating. This is where we grasp the transcendental method manifested in the data from experience, in the grasp of the intelligible and in the affirmation or negating through the judgements.

During the modern times science underwent a revolution what was termed as scientific revolution. Aristotle's science which was celebrated during the ancient times, was rejected, disregarded and rubbished. This is because the new scientist discovered a lot of inadequacies in his teaching. Particularly, his theory of Geocentric was brought down because it was unfounded. Scientists rejected the sensible observation and experience-based science of Aristotle. They mounted elaborate observation aided by use of instruments and experimentations. They discovered that Aristotle erred in his teaching that all planets revolves around the earth. Through the use of telescope, they widened their experience, they made their experience more attentive and clearer. Out of this, Copernicus discovered that all planets revolve around the sun and that earth is one of the planets. In the *Commentariolus* Copernicus listed assumptions that he believed solved the problems of ancient astronomy. He stated that

> The earth is only the center of gravity and center of the moon's orbit; that all the spheres encircle the sun, which is close to the center of the universe; that the universe is much larger than previously assumed, and the earth's distance to the sun is a small fraction of the size of the universe; that the apparent motion of the heavens and the sun is created by the motion of the earth… (Copernicus, tran. Commentary, 1973)

Perhaps of great surprise was Aristotle's teaching that all bodies fall because they are looking for a place of rest. The New scientist did experimentation and found that bodies fall because of force of gravity which they measured and calculated to be 10m/s. This and many other discoveries made scientist to change the methodology used by Aristotle. There was a shift from deduction to induction. Induction is a process where one reasons from simple observable instance to the general laws or principles. Due to this shift in methodology, there was a change in the way science was conceived. With the elaborate and increased experimentation and use of instruments, observable data were enlarged and this widened the experience and brought about more precision

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and accuracy. This essentially brought a different experience about nature and the world which ultimately changed the situation of the reality. Great scientist like John Kepler, Copernicus, Einstein, Newton and Galileo put their eyes on the ground, and did more experiments which expanded the horizon and increased their worldview. This prompted the change in Aristotle teachings and theories about the universe and the world. Specifically, a shift was made from relying on the authority of Aristotle to relying on experimentation and verified discoveries, facts and evidence. This was emphasized by Francis bacon whose philosophy rejected on relying on authority and instead advocated the **empirical method** and **inductive reasoning** where people piece together truths from their own experience. This was a major opening for the scientist of that time because they laid emphasis on this.

They now relied on a new science which was coherent, integral, and demonstrable, whose basis was on induction as new scientific method. The new scientific method incorporated the use of experiments, mathematics, measurement and technology as the basis of clarifying their theories and pronouncement before they could verify them. Furthermore, the new science attained a new way of looking at the world. Great accuracy, great precision, great certainty and necessity was the major features of what was witnessed. Moreover, the new science refocused in reaffirming its terms and relations. They clarified them according to the new procedures and processes that had been brought by the new thinking.

Additionally, mathematics that was an independent course in Aristotle time, now was incorporated into the normal working of sciences. The use of algebra, trigonometry, and calculus opened a new horizon. This made natural science to be the most precise and accurate discipline and this impacted positively on scientific knowledge and made it the most certain and necessary. In particular, Pythagoras dream of making the world to be known through mathematical law was achieved and realized during this period. This is shown when the new scientist wanted to understand the world using mathematical numbers. Particularly, Galileo Galilei made original contributions to the science of motion through an innovative combination of experiment and mathematics. Movement, time, space, speed, velocity and acceleration were expressed in mathematical formula.

The use of instruments in measurement was not only valuable step, but also, a crucial step in the sense of attaining accurate observation and precision. Baird (2004) emphasized this point by saying that the scientific knowledge must be embodied in skills and in instruments themselves. His central example is analytic chemistry. For instance, Galileo Galilei, the father of modern science and scientific method was able to explain the falling object by measuring the distance and time they took by using experiments involving a pendulum. His findings shocked the world. Galileo proposed that a falling body would fall with a uniform acceleration as long as the resistance of the medium through which it was falling remained negligible, or in the limiting case of its falling through a vacuum (Galileo, 1954: 225). Through such prolonged measurement and correlation of motion to time, he was able to discover, explain and affirm the existence of force that was pulling all things towards the center of gravity. He called this the force of gravity.

Further, Galileo made fundamental discoveries about motion. In particular, he came up with the principle of relativity which held that the laws of physics are the same in any system that is moving at a constant speed in a straight line, regardless of its particular speed or direction. This pronouncement clarified two controversial notion that had been taken for granted since antiquity, that is, the notion of absolute and relative motion. For him, there is no absolute motion or absolute rest. This principle broke the ceiling which had not been attained by any scholar and was the basis upon which Newton's three laws of motion were midwifed. (Cohen, 1676) Notwithstanding this, the new scientific discoveries were incorporated into various innovation in various fields. This impacted positively on people's life and saw a tremendous result. It is this progress that made

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scientist reject humanities and philosophy and regarded science as superior. This bore the name scientific revolution.

2.2.1 The Scientific Method

What was the new method that came with scientific revolution? From the outset, it is good to mention that major revolutions supposedly change the normative landscape of research by altering the goals and methodological standards of the enterprise. During the Scientific Revolution, there were two striking things which influenced the scientific atmosphere. First, there were renewed effort to find out the changing perceptions about the role that the scientist was playing in respect to the discovery of nature. Secondly, there was a renewed concern about the value of evidence which was supported by experimental or the use of instruments. This was against Aristotelian way of thinking where science depended on observation and the study of nature through deductive reasoning. Again, as a matter of fact, there was tension between the traditional science and modern science. Kuhn called the "the essential tension" between tradition and innovation (Kuhn 1959, 1977a). With this in mind, the scientist identified a different method in the study of the world and man. In particular, scientific method set aside any belief, opinion, conviction, notion and myth about the world and strictly relied on systematic experimentation. They resorted to the use of inductive approach to obtain knowledge.

As a method, scientific method ensured that the process of observation was done with an open mind, this is followed by carrying out experimentation. Through experiments data observed is able to be managed and clarified before one can think and formulate what is general to all possible instances. This is important because it enables one to interpret, theorize, suppose, conceptualize, formulate and finally ascertain ideas before doing verification. This process can be repeated several times till clear and distinct knowledge is attained. The verification of scientific investigations, postulates, theories, ideas, and principle is meant to find out which among the many wise guesses was true, correct, indubitable and reliable. This shows that science need a foundation and it is only in epistemology for without it science will be regarded as "primitive and muddled" (Einstein 1949, 684).

From the above, we have witnessed that science is not without epistemology. This is makes science a natural discipline dealing with day to day observation and phenomenal life. According to Einstein, "the whole of science is nothing more than a refinement of everyday thinking" (Einstein 1982, 290). This conviction underlies his own explorations of the nature of thinking be-yond the bounds of science. Scientist are interested in coming up with a body of knowledge that is certain and credible. They are possessed with the question of truth, objectivity and criteria just as philosopher and other disciplines. The three stages above, that is, observation, experimentation and verification which culminates to scientific knowledge are both structural and cognitional. According to Hackings, scientific styles of thinking & doing are not good *because* they find out the truth. They have become part of our standards for what it is, to find out the truth. They establish criteria of truthfulness. … Scientific reason, as manifested in Crombie's six genres of inquiry, has no foundation. The styles *are* how we reason in the sciences (Hackings, 2012:605) In other words, in them we can identify the object and the activities of those objects. Below is an analysis of scientific method and the various cognitional acts involved.

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Table 2: Levels involved in Scientific Knowledge

Level Judgement	**Verification**	**Scientific facts**
Level Understanding	**Interpretation**	**Scientific/ Formulations**
Level Experience	**Experimentation**	**Utterances/instances**

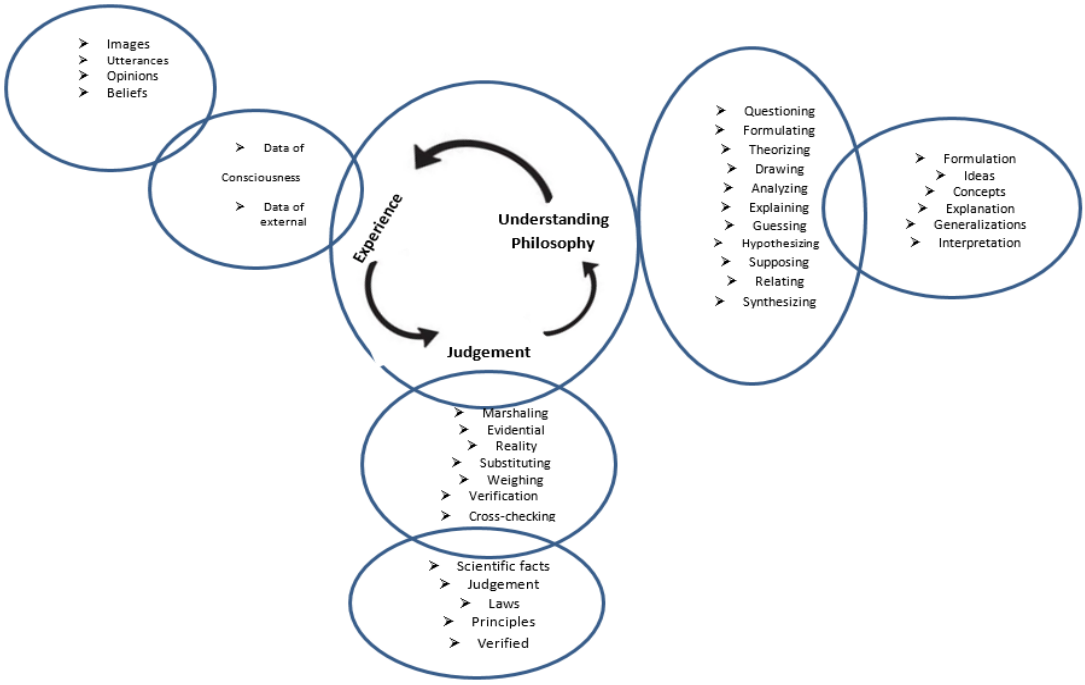

Figure 1: Cognitive Activities in Scientific Knowledge

Generally, scientific method starts with the lowest level where by a scientist is confronted with an object of inquiry i.e. a falling object. A scientist finds that such falling is not accidental but necessary. As well it can be a situation or a phenomenon or an instance. Sensible images and utterances are built out of the interaction with such situation. This images alone are unsatisfactory because they are depended on believe and assumptions. Due to this, a scientist is prompted to observe thoroughly and put down patterns of the occurrences. This pushes them to do experiments to ascertain the aspect under investigation.

During this stage, the scientist asks various questions about the investigation. They carry out experiments which brings out various ideas, suppositions, formulation, and hypothesis or theories. This being the case, the human mind works in such a way as to demand for a correct answer, or theory or concept out of the many ideas. This stage is not easy because it is the level where intelligence is at stake. The intellect questions, supposes, interprets, suggests, formulates, errors as it systematically and objectively thinks through and through. When this questions and answer dies

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gradually, the intellects get an insight into the correct answer or explanation. This is not the last journey of the process of knowing. The mind further is pushed by the imperative of reasonableness where it demands that one has to verify the formulation or supposition or theory that he has come up with from the experimentation and thorough inquiry. This transitions the cognitional activities from those of seeking to understand to those that are seeking to affirm or deny. This is what scientist call the stage of verification. Here scientist go back to the initial problem, and insert the concept that he has come up with to ascertain whether it is correct. This process is guided by the proximate criterion of truth which demands that through reflection one grasps the sufficiency of evidence before a given pronouncement or conclusion.

Cronin (1999) says that a critical evaluation of the evidence that justifies the conclusion and becomes the answer to the question, is it true, does it exist, can it be affirmed comes up spontaneously because the desire to know drives one to be clear, distinct, correct and factual. This is quite similar to all empirical sciences which depend on observation. Sciences like psychology, sociology, political science may not go to the laboratory as such but they follow the same procedure or process where in the levels of experience where data is presented; the level of understanding where the data is questioned, interpreted, discussed and formulated; and the level of judgement where the what has been understood is verified and affirmed or negated.

All empirical sciences are thought to operate as pertains to this direct mode of cognitional process. The inquiring, and critical spirit in man trigger this transcendental methodology of advancing from data to insight, to formulation, to reflection and finally judgment. This critical spirit is behind all the acts of questioning that aims to understand and understand correctly. Lonergan captures this point in one of his tricky topics called the notion of judgment. He comments that "by question is meant the attitude of the inquiring mind that effects the transition from the first level to the second and, the attitude of the critical mind that effects the transition from the second level to the third." (Lonergan, Insight, 1957:274).

2.3 Mathematics

Mathematic is one of the areas that many scholars are interested in. This is because it deals with almost all disciplines and general dimensions of life. Due to its vast nature and concern, it is very difficult to define mathematics in a precise sentence or terms (Richard Courant and Herbert Robbins entitled "What is Mathematics). It is true that today there is a discordance as to where mathematics should be placed. For instance, is mathematics an art-based subject or science-based subject? This question has remained unanswered and inescapable in all areas of study because all discipline at least uses the common basics of mathematics. Firmly and concisely, there is no research be it qualitative or quantitative that does not use mathematics. Needless to say, any chronological account can only be done well if it uses mathematical numbers and measurement. With this kind of confusion, it is good to ask what really mathematics is.

The term mathematics comes from the Greek word mathema which literally means, 'that which is learnt' that 'which one gets to know or study.' According to Aristotle, mathematics is the science of quantity or measurement. Traditionally, mathematics is defined with a leaning towards science and not arts. Mathematics, therefore can be defined as the scientific study of quantities, including their relationship, operations and measurements expressed by numbers and symbols. In mathematics dictionary (James & James). Mathematics has been defined as the science of logical study of numbers, shape, arrangement, quantity, measure and many related concepts. Today mathematics has grown its relationship with science which has seen it being defined as a science that investigates abstract structures and their inherent properties and patterns.

Mathematics deals with four major concern which relate to the cosmos and man. These are; quantity, structure, space and finally change. The above four mathematical concerns distinguish

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mathematics into four main divisions, which include, Arithmetic, algebra, geometry and analysis. While this is the case, mathematics is dedicated to other areas of study in a special way. For instance, logic and the empirical sciences which has today come to be known as applied mathematics. Their main interest is to solve and predict various occurrence in relation to frequency, median, and the middle. Generally, mathematics is life science whose concern is to understand the life experience and seek to find out how one can be able to accurately estimate and predict their pattern of occurrence through a correct formula or theory that can be used to explain similar cases. In other words, the concerns or the major interest of mathematics is to deal with the assumptions, properties and applications (Yadav d k, Exact Definition of Mathematics 2017:34). Perhaps what is important to pin down is the method what mathematician use in their entire process of knowing.

2.3.1 Mathematical method

Mathematics is one of the oldest disciplines. It is thought to have been started by philosophers in the ancient times who were interested in numbers, quantity and magnitude of the visible universe. The first philosopher who showed interest in numbers was Thales. Thales was interested in almost everything. He investigated almost all areas of knowledge; philosophy, history, science, mathematics, engineering, geography and politics.

In particular, he is the founder of mathematical axiom and theorem that are used up to date. He took the geometrical skills which were in use in Egypt in measuring and remeasurement of plots of land after the destructive inundations. The surveyors were able to measure and to calculate because they had outstanding practical skills. The development of geometry is preserved in a work of Proclus, *A Commentary on the First Book of Euclid's Elements* (64.12-65.13). Due to this profound knowledge from the Egyptians, he was capable of coming up with various concepts in geometry on how to measure length and form angles.

Thales further came up with an elaborate theorem and used them to solve practical problem. This happened when Thales put forward various propositions and went ahead to prove them by way of repeated experiments to ascertain whether they were correct. This fundamental process points out to an early use of inductive process by mathematician. To verify his propositions or hypothesis, he invented a technique of proving his answer by subjecting his calculations to a process to find out whether they could show contrary outcomes. This method is also regarded as a method of exhaustion where you subject the calculation to thorough evaluation and substitution to verify them through inductive demonstration. Due to this, Thales is renowned to have come up with the definition of a diameter of circle as a straight line drawn through the Centre and determined in both directions by which later on came to be polished by Euclid (Proclus, 124). He discovered the isosceles triangle and defined it as a triangle with both of its angles at the base being equal (Proclus, 244).

After long experiments, Thales discovered that the angles on the base of an isosceles triangle are similar, he called the equal angles similar (Proclus, 250.18-251.2). Furthermore, he discovered what is today known as angles of a circle adding to 360c. He saw that when a straight line cut one another, they make up vertical angles equal to one another and this totalizes to 360. (Proclus, 299.2-5). Thales is renowned to have asserted that If two triangles have the two angles equal to two angles respectively, and one side equal to one side, namely, either the side adjoining the equal angles, or that subtending one of the equal angles, they will also have the remaining sides equal to the remaining sides and the remaining angle equal to the remaining angle' (Proclus, 347.13-16).

Notwithstanding the discoveries that were made by Thales, Pythagoras is perhaps, the most respected mathematician of the ancient times. He is regarded as the father of mathematics. One of the most used and beautiful theorems in math is the Pythagorean theorem. This is credited as the

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first theorems and proof and it is one of the most well-known mathematical theorems in the world. It is part of the elementary mathematics that is used to introduce learner to mathematics. This theorem was invented after a long and elaborate struggle to put together the basic terms, concepts and relation together to understand how such correspond in actual figure of a triangle.

What is interesting in this discover is that Pythagoras had nobody to guide him. He attempted to put together what he already knew as the basics in mathematics. For instance, he must have known something about line, perimeter, actual drawing of a triangle, square and rectangle. Perhaps, he also knew what happens when line crosses each other in a particular form. Out of this experience, he postulated through trial and error a kind of theory that can be able to connect the three sides and bring out a desirable and rational connection. Therefore, the Pythagorean Theorem or Pythagoras' theorem is a relationship between the sides in a right triangle. A right triangle is a triangle where one of the three angles is 90-degree angle. In a right triangle the sides are called legs and hypotenuse. The history of the theorem is also connected to the discovery of Pythagorean triples which consists of three positive integers such that c2=a2+b2. The three integers 3, 4 and 5 is a well-known Pythagorean triple because 52=32+42

What is evident in all these is that after the entire attempt, Pythagoras was only able to firmly and strongly confirm this theorem after thorough scrutiny and use in various triangles. He must have tried to use the theorem in other forms to triangles like isosceles but it failed. The inductive demonstration was very important to proof that this theorem worked. It only worked for right angled triangle and that proved beyond reasonable thought that it worked.

The process of verification is important not only to Pythagoras or the pythagorinian who constructed the first known algebraic proof of the theorem, but also to all the subsequent mathematicians. Therefore, this explanation connecting the sides in a right triangle has been credited to him after it has been proved to work and after it has been found to be necessary and universal. Its necessity has been recognized because you cannot avoid it when calculating the area of a right-angled triangle. Its universality is contained in the very fundamental aspect that it can be used everywhere and it will produce same and similar results in every case of the same nature.

In the recent modern times, two great men stand out as great icon in mathematics. They are regarded as fathers of mathematics in the modern times. There are Gottfried Wilhelm von Leibniz and Isaac Newton. Leibniz is renowned in two great things in mathematics. Having not studied mathematics as a discipline, he was challenged with various probing situation which could not be easily explained. Having been a good student of Philosophy He applied his background in logic and philosophy to creatively reformulate contemporary mathematics into an improved system of notations. This saw him develop an algebraic symbolism that aimed at freeing mathematics from much of the rigid verbal structure. This really helped mathematics to develop faster in the sense that algebraic expression could be formulated in symbols in the process of calculating the unknown variables. This came about when he interacted with what the mathematicians had written because he was not a student of mathematics.

With logical principles which are similar to the mathematical axioms, Leibniz viewed the subject from his own lens. This forced him to gather interpret and process many contemporary mathematics writings and reassessed, analysed, synthesized, and finally redefined and reformulated them into a superior product. Out of this elaborate process Leibniz came up with a new technique and formula in mathematics which he called new notation. This became the greatest contribution to mathematics and as witnessed in his private notes from 1675 that Leibniz first introduced the modern symbols for integration and differentiation. (1675 3, p. 74). Leibniz is generally considered, along with Isaac Newton, as a cofounder of the differential and integral Calculus. For this reason, Leibniz's achievements are often compared to that of his subsequent rival from England. It can be

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said with almost complete certainty that he did not have the raw mathematical skill that Newton possessed.

On his part Isaac newton is not only a physics who came up with the laws of motion but also a great mathematician. His insurmountable contribution is expanding the use of calculus in geometric form based on limiting values of the ratios of vanishingly small quantities. This discussion takes much of his consideration in the *Principia* where Newton gave demonstration of this under the name of 'the method of first and last ratios' and explained why he put his expositions in this form (Newton, *principia*, English tranl 1729:49). This has made many modern and contemporary mathematician to regard Newton as possessed with the theory and application of the infinitesimal calculus.

From the ongoing discussion, Mathematics is one particular case where the heuristic process and technique is seen to have been embraced and used. This technique has a lot of similarities to the one used in philosophy and sciences. It starts as we have seen with a mere puzzle; then actual working out starts which involves putting one's experience and data into question. The second stage comes in with a need to understand correctly the observation which is represented by the data. One asks questions about given content, experience, phenomena, or challenge posed by a given formula which is inadequate to solve a particular problem (Leibniz).

We ask about something. We ask about our experience of particular instances and particular concrete things. Our first questions on our experience are questions about what, why and how often. Aristotle concurs and says questions posed here are about the concretely given or imagined. For him, it is this wonder, which is the beginning of all sciences and philosophy. Based on the principles that similar are similarly understood, the process of questioning and elaborating the data produces some hypothesis and suppositions which can be able to produce understandable and intelligible patterns which mathematics in often interested. This goes on and on as one attempts to formulate, to conceptualize and postulate the meaning and correlations. This eventually leads to some kind of rational explanation. When an insight or discovery is made, before one pronounces it, the need to verify emerges.

Verification is the process of going through the process to ascertain if truly the puzzle can be solved with the explanation, theorem or formula that has been discovered after a long brainstorming, experimentation, inductive processes and repeated examples. According to G., Polya, modern great mathematician, mathematics is a heuristic technical problem which needs a heuristic technique. For him, mathematics cannot be solved through a set of rules and terms to be followed, but a general heuristic strategy to be implemented towards a particular solution. He summarizes the broad strategy into four parts.

First, one need to struggle to understand the problem. This is what we have referred above as understanding the puzzling which usually comes out of experience and the nature of human being inquisitive delves into inquiry. The second stage is to identify similar cases, experiences and problems and highlight how they have been solved. Third, carry out an attack. Leibniz did this by first doing a survey and corrected all the outstanding mathematical writing and studied them. He attacked the works and the proposal and was able to show the inefficiency. This is similar with the stage that we have referred as the level of understanding in our diagram above. This takes long. Here various experiments are carried out to tease out and refine what can be the best explanation. Calculation and the use of various technique come in at this stage to enable one come with various possible explanations.

In this stage, mathematicians' endeavor to work out the equations, find the coefficients, differentiate and integrate with a view of coming up with a viable, usable and genuine mathematical formulation and accounts. The fourth stage which is rather crucial and significant. It is the one we have regarded as verification. Here mathematicians go back marshaling mathematical

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demonstrations and evidence to check backwards, substitute the answers one has gotten in order to verify which the correct one is. Here one tries to falsify the answers to see if there is any mistake or loopholes.

In the above process and steps which are done by mathematician we have identified and shown how it fits appropriately in the heuristic structure of transcendental method. It has become evident that such heuristic structure is not only found in mathematics but also in science, philosophy, history and other discipline where proper epistemological processes are followed in the attainment of knowledge. This is essentially to say that it doesn't matter which discipline one is engaged in.

As long as one is interested with a proper and credible knowledge, cognitional activities and process are the same in all these disciplines and studies. This is to say that all proper knowing must embrace a heuristic structure (Lonergan, 1957). This is the dynamic structure in our mind which enables us to move from images to ideas, from the sensible to the intelligible, from the known to the unknown (Cronin, 84: 2001). This heuristic dynamic devise helps any person engaged in knowing to move from the unknown to the known (Cronic, *Foundation of knowledge*, 2001:88) Furthermore, this heuristic enables one to have a clear direction to the search because there is an anticipation of the known while it is unknown. This technique is dynamic because it uses human dynamic and cognitive activities in pursuing knowledge.

The process of knowing should not be taken to be easy as such. The act of experiencing, questioning and understanding which are involved are not simple or automatic. It is painstaking in the sense that while data may be given, the act of questioning is the first manifestation of intelligence. This act of questioning is geared towards the purposiveness of knowing. Not just questioning abstractly but one which is directed first to the data or content of one's experience that is probing to be understood. This process does not end in mere understanding but the mind still seeks for a correct understanding which only comes to be known through verification or judgment of the reality and factual nature of it all.

2.4 History as a Study

The insatiable appetite for more and more understanding of the human situation has pushed man to seek knowledge not only of the present and future universe of proportionate being, but also, for the past. The shift to the past is meant to link whatever we see in the present with what existed in the past. This is what is regarded as history. According to peter Kosso, history means the events, the people, and objects in the past, what happened, what was there, who did what. At other times, "history" refers to the discipline and what it does, namely describe the human past (Kosso, companion 2009:24).

To be precise, the past is meant; the cultures, traditions, ethos, believes, norms and the practices. Perhaps, the reason for this is that man wants to know whether today's happenings, phenomena, events, occurrences and reality have any connection with the past which shaped the human situation in various epoch. Secondly, and of great importance is that history would want to find out whether this connection from the present to the past is logical or merely coincidence, twist of fate and temporal. This is done by historical researcher whose aim is to move from what is the physical phenomena to the thought of those phenomena. (Boucher 1993: 705) This is really to say that the process of thought is what should preoccupy the minds of the historians when approaching a subject. According to Collingwood's there are two distinct ways to look at the study of history. The outside and the inside of an event its "observable physical properties" and its 'thought processes' (cf. Collingwood 1993: 118)

What is history? Perhaps every one claims to know history as a study of the past events. Sometimes other scholars have made it look so simply to mean the narration of the past event.

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Event can either be human experiences, artifacts, cultural, traditional, human pursuits and attraction or the totality of human past experience. As a matter of fact, historians have distinguished two types of history which will be of paramount concern for this discourse. They include, historicity and historiography. There is a distinction between the two divisions above. To start with, historicity, on one side, is the study of phenomena's concept, practice and values as they unfold in the human past. Here historians seek knowledge about human artifacts, events, culture and traditions.

On the other side, historiography is meant the systematic, objective and rigorous study of account of human past and the kinds of investigations which is used to construct it. Historiography tends to "utilize ordinary or natural languages for the description of its objects of study and representation of the historian's thought about those objects." (White, 1995: 244) In other words in the study of history, one does not only describe or narrate past events, happenings and phenomenal situation. Instead, as indicated in historiography a systematic investigation into the account, principles and contents of that knowledge is undertaken. This undertaking is not without an established method and procedure.

To be a good historian, therefore, one has to be in possession of those principles which underlie and control the relevant historical processes taking place in time and space. This means that any discovery, exploitation and exploration which is made in history must adhere to these principles. These principles are not unique only in history but are common to all disciplines. They are mostly indicative of a particular logic and epistemology that is sound, reasonable and critical. These rational principles also lay a beacon for the scope and province of historical knowledge. According to Aviezer Tucker ed., the philosophical issues in the analysis of historiography are almost entirely epistemological. Most of the core concerns of epistemology are present in the analysis of describing and knowing the past. This core concerns are more on method, objectivity and truth in study involved in history.

Furthermore, these principles must somehow boil down to the encompassing epistemological presumptions in order for them to guarantee any amount of certitude and validity. This ideally is to say that history as discipline adheres and is revitalized by epistemology in that epistemology seeks to clarify historical suggestions, principles and methodology used in explaining and establishing historical content, explanations and pronouncements.

2.4.1 Historical Method

Most significantly, historical method has been taken to be the simplest of all methods. Scholars on this fold maintain that history only describes the events so that other disciplines can pick them and study. According to Lange, social scientific approaches usually perceive the historical method only as a preparatory method providing evidence for the subsequent secondary methods such as causal narratives, process tracing and pattern matching (Lange 2013: 43-55). This position is accurate because history as we shall see goes beyond mere description to the inner explanation of what is observed and existed in the past. It is not true that history is not systematic and rigorous in its pursuit.

Notwithstanding this, historical method has stood aside and emphasized the following broad procedures and stages of studying history. They include the following: the stage original history, the stage of reflective historical and lastly philosophical. These three are different because of the level of operation however they all must coalesce into a single history.

To start with, original history is emphasizing on describing external phenomena so as to present past event as clearly as possible. The use of description is limited to deeds, events and state of the human society which one saw, heard, and witnessed and those spirit which they shared. Those things which they didn't witness, they relied greatly on other people's accounts, experience

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and encounters. Generally, this level of history is more elementary and simplistic. It is the rudimentary history which is usually accompanied with narration and mythology. The method used here is description, observation and narration. According to Lange, here researchers employ historical narrative for descriptive purposes, that is, to document what happened and what the characteristics of a phenomenon were" (Lange 2013: 56). This level merely presents what is believed to be the reality, the experiences as brought out by human situations and what is given by others.

The second stage of history is that which philosophers of history have referred to as reflective history. Contrary to the original narrative and descriptive history, this level of history exploits a different method altogether. The use of formulation, explanations, supposition, relation and correlation is highly consumed in bringing out human historical knowledge. Here, it is not only that which was witnessed, experienced and observed that is written, but that which makes meaning to human situation. This level makes use of systematic abstraction of what is common among the various historical facts and forms a pattern of meaning which is finally put down as generalization. According to Marwick, concepts, generalizations, and indeed theories are integral to historical study. But all must emerge from the evidence, be constantly tested against the evidence" (Marwick, 1993: 133)

Historian in this level are guided not by the content but by the spirit of the history. According to this form of history, the former delivers a descriptive "data base", while the latter focus on drawing inferences and, ideally, extracting and explaining alleged causal relationships (Lange 2013: 42). This is the focus of the second level of historical method where historian major concern is to conceptualize, describe, contextualize, explain, and interpret events and circumstances of the past.

The activities that are involved in coming up with these historical assertions involve questioning and formulation. Intelligence is at the pick at this level and it seeks to grasp the relations of historical patterns and data given in various account before coming up with what makes meaning about a historical reality. What is perhaps unique here is the use of the construction of the past to establish fundamental truths about the present. Hegel saw this as a level of fruition of both pragmatic reflection or didactic. Due to this, this level is regarded as an abstract construction of the past in the present. This level fits so much to the second level or stage in of the philosophical, scientific and mathematical method that we have alluded. In essence, this is the stage where the process of understanding is carried out from a given data and observation to formulate given laws, correlations, explanation and generalizations.

The last form of history is that which is regarded as philosophical history. What is peculiar in this stage of history is that it occupies a level where the method of study is that of justification of various account and expositions. Here historian subject all that they have grasped in the original history and in the reflective history to philosophical justification. By justification is meant the technique where one looks for reasons to pass a given account in history as either true or false. This is done by verifying all the procedure that has been involved right from original- narration, to reflection- explanation and formulation. This is important in order to pass a judgment of historical facts and give affirmation that they are reality. This process is not easy.

In the study of history, we are interested in people in the past, their actions, ideas, and accouterments. All we have to go on as evidence are their textual and material remains. According to Aviezer, any one claiming to know about the human past is thus claiming to know more than is immediately perceived, and this raises questions of accuracy (Aviezer Tucker, 2009:10). These questions can only be addressed following a model of epistemic justification which is supported by fundamental principles of philosophy. This indeed makes it inevitable for history to be inseparable from philosophy, and more particularly not to be inseparable in their methods of inquiry.

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More fundamentally, in this level the historian moves beyond the material components of history, to explanation and further to the level of thoughtful consideration of human historical events. Moreover, historians, like philosophers, scientists, mathematicians build upon discoveries of their predecessors. Here they read, interact, internalize and where necessary come up with positive enrichment of the previous work through bringing new evidence, new techniques, and new approaches to bear in refining, correcting, and, sometimes, rejecting existing interpretations ((Marwick, 1993: 114). This ideally mean that the transcendental nature of historical knowledge allows the revision of historical facts, evidence and explanations through the process of new experience which seek further understanding, and which finally provides a ground for new judgment. Lonergan in *Insight* while elaborating on transcendental method, realized that even after the three level of knowing has ended and judgment is draw, emerging experience can widen one's data which will prompt further questions which will lead to understanding and better judgment. He says:

> Again, from the same viewpoint, the judgment may be described as the total increment in cognitional process. Every element in that process is at least a partial increment. It makes some contribution to knowing. But the judgment is the last act in the series that begins from presentation and advances through understanding and formulation ultimately to reach reflection and affirmation or denial. Thus, the proper content of judgment, the 'yes' or 'no', is the final partial increment in the process. (Lonergan, Verbum, 1967: 360)

The historian focuses more on philosophical foundations of whatever they accept as a body of knowledge. Furthermore, history works like other disciplines in that it is evidence based. According to Marwick, Historians, in his view, "operate in the same spirit as natural scientists, always working from the evidence, always basing their generalizations, interpretations, or theses on the evidence (not on metaphysical speculation). (Marwick 1993: 128)

This shift is based on the view that thought and philosophical thinking is essential to humanity. Hegel made this remark about these three stages in historical study as follows: - in this historical method reason is the core spirit which guide man's understanding and it presents the world with a rational consciousness. He had a strong conviction that history is the process whereby the spirit discovers itself and its own concept. (Hegel, 1857:62). This is really to say that in philosophical history, reason becomes an essential component for it commands, organizes, structures, discovers and brings into order everything in the world.

2.5 Structural Presentation of Scientific, Mathematical, Theological and Historical Methods

In regard to the above explanations on how scientific, mathematical, theological and historical method are done, one can conclude that they all have the tripartite levels of knowing which comprises of a moment of experience where data is presented through observation, narration, beliefs or introspection. Understanding where there is a moment of questioning, analyzing, hypothesizing, theorizing, supposing, calculating, interpreting and finally formulation of the possible solutions. Lastly, the moment of judgment where there is marshalling, weighing, substituting, affirmation, negation and verification of judgment of fact principles or theorem.

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The following figure sums up this position:

Figure2: Transcendental Model Manifested in other Disciplines

Conclusion

In this article, a critical survey has been made showing how that transcendental philosophical method can be used as foundation of all methods of studies in natural and empirical sciences, mathematics, theology and history. As such it has been shown that transcendental method underpins all areas of studies. As a method it allows the use of personal and intrinsic dynamism of the human knowing which emphasizes on experiencing, understanding and judgment as a tripartite cognitive level through which all knowledge must pass. As evidenced from this study, transcendental method is applicable not only in philosophy, but also in natural and social science, mathematics, humanities-history. This article concludes that genuine knowledge in whichever discipline must embrace transcendental method for its sound and solid development.

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