Philosophy and development of greek and chinese mathematics philosophy essay

ASSIGN BUSTER

At a glance, Greek mathematics would appear to possess the most influence on modern mathematics from methods of integration (developed from Eudoxus' method of exhaustion) to the rigid logic adhered to in modern mathematics and would thus explain this thesis' choice of comparing Greek mathematics.

On the other hand, ancient Chinese mathematics appears to have differed largely from Greek mathematics in terms of development and for that reason was chosen for comparison in order to explore the possibilities of philosophical influence in mathematical development.

Not only will this thesis explore the differences in the development of the respective mathematics and the factors involved in these differences, it will also explore the possible relevance of such findings to mathematicians in the further development of modern mathematics.

However, given the rich history of each respective culture's mathematics, it would be next to impossible to explore their developments in vivid detail and as a result, only a basic overview of the characteristics of the mathematics prior to their interaction (when Matteo Ricci – western missionary began introducing western concepts of mathematics to the Chinese) would be explored.

Greek Mathematics?

Easily identified by its focus on generalized mathematical theories and proofs, the Greeks seemed to have an idealized perception towards mathematics where instead of grounding them in reality, it was a goal to make mathematical concepts even more abstract. At the foundation of

Greek mathematics were basic assumptions known as axioms. These axioms could neither be proven correct or wrong, and are considered self-evident. New theorems were derived from these axioms, and this happened in a process where conclusions were drawn from premises through the use of logic, otherwise known as deductive reasoning. An example of such use of deductive reasoning would be the 10 postulates (similar to axioms) seen in Euclid's Elements which were used by Euclid to prove his various geometric theorems.

Such a method of proving and deriving theorems deductively could be effectively seen as a form of abstraction, where abstracted theorems could be applied in any case related to the theorem. For instance, (Pythagorean Theorem) would be true for all cases of right angled triangles regardless of the numbers substituted into the theorem. Pythagoras was thus attributed to be one of the first men to grasp numbers as abstract entities.[1]

With the prevalence of the use of deductive reasoning in the ancient mathematical schools of thought from the Sophist School to the Platonic School, it could be generalized that ancient Greek mathematics was characterized by abstract theories and generalized proofs.

Chinese mathematics?

The concept that the Chinese had of mathematics was radically different from the way the Greeks handled math. Instead of an axiomatic approach to mathematics (developing mathematics based on assumed axioms), the Chinese developed a far more practical approach.

Science was valued for its many practical applications and astronomers in ancient China were also mathematicians who calculated planetary movements through the applied use of mathematics. Applying mathematics was seen even in the Jiuzhang Suanshu (considered one of the most important mathematical manuals in China to be written) which was in essence a collection of problems and rules that was applied practically. For instance the second chapter (Su Mi) of the book dealt with percentages and " proportions for exchange of cereals, millet, or rice" and helped in the production and management of grain. Chapter 6 (Jun Shu) allowed the calculation of proper distribution of grain and labour and dealt mainly with the problems of taxation of the people.[2]

This problem-based approach revolved around the idea of applying the solutions of one problem to another in such a manner that would allow the other problem to be solved. For instance, the Jiuzhang Suanshu or Nine Chapters on the Mathematical Art is in reality a collection of mathematical problems and their solutions. Mathematicians were then expected to extrapolate from these solutions other solutions to other problems. In the words of the Zhoubi Suanjing (one of the oldest complete mathematical manuals found in China), " a person gains knowledge by analogy, that is, after understanding a particular line of argument they can infer various kinds of similar reasoning".[3]

Given that the majority of the mathematical manuals discovered in China possessed the attribute of problem-based approaches (Jiuzhang Suanshu, Xu Shang Suanshu, Suan shu shu) are just some examples), we can easily

conclude that the ways in which the Chinese approached mathematics was radically different from that of the Greeks.

Greek and Chinese Philosophies

Having understood the differences between the mathematics of both cultures, we must now begin to explore the possible causes of such a difference, and we first take a look at the philosophy that has guided the respective cultures.

Greek Philosophy?

Although it is commonly agreed that Socrates, Aristotle and Plato were one of the few greatest philosophers originating from the Greeks, the father of deductive mathematics – Thales, contributed to ancient Greek philosophy even before the great philosophers and with his close association with the origins of Greek mathematics, it would be a mistake not to consider Thales' contributions to the philosophy. Thales belonged to a school of thought called the Milesian school and these philosophers believed that all things were defined by their quintessential substance, which Thales thought was water.[4]

Regardless of what Thales or any other philosophers from the pre-Socrates period of philosophy thought, it was clear that from the beginning the Greeks had already begun to seek out a basic form or substance that all things would be defined by. We thus begin to see similarities between their goals of having a unifying substance that would define all things in philosophy and in mathematics, where they sought abstracted theorems and mathematical proofs that would have applied to all cases of any related problems.

Even Plato, in Book VII of The Republic, argued for the existence of Forms in his allegory of the caves. He believed that what we thought to be real were simply shadows cast by actual Forms that we could not really see. Plato argued that these non-material abstract Forms did not exist in time and space, and were not the material world that we perceived with our senses. Plato even suggested that only through the study of these Forms were we able to attain genuine knowledge.

Through these ideas of abstract forms and substances that Greek philosophy seemed to follow, we begin to see that there is a general direction in which both philosophy and mathematics went: abstraction.

Chinese Philosophy?

When compared, it is clear that the philosophies of the Chinese differed greatly from that of the Greeks. Where the Greeks asked questions about the possible existence of a monotheistic deity, the Chinese were more concerned about the development of philosophy as an ethical and practical guide.

Confucius was a philosopher who taught the importance of virtue and moral perfection. He explored ideas of humanity, loyalty, piety and the characteristics of a gentleman (a perfect man) in his teachings. The most fundamental of which, humanity and righteousness have since been argued to form the basis of morality.[5]In the Analects of Confucius, he explores these concepts of moral perfection and explains the importance of individuals of authority possessing these attributes.

Confucius’s philosophy possessed dimensions of practicality which was seen from that fact that his teachings about piety were essentially descriptions of

specific duties that an individual had according to his relationship with another. For instance, Confucius believed that a child should have respect for his parents and that parents should in turn love and care for their children.

Being one of the main schools of thought in Chinese philosophy, Confucianism is thought to have had tremendous influence on the culture and history of China.[6]Additionally, in other Chinese philosophies such as Buddhism and Taoism teachings we see a form of instruction on a practical level (Buddhism instructed on how one should live in order to attain enlightenment).

Although a lack of credible literature fails to either prove or disprove the influences of Chinese philosophy on their mathematics, one might argue that the general direction in which Chinese philosophy has taken appears to be similar to that of their mathematics.

Other factors influencing mathematics?

Although little is found regarding the history of the Greeks that could have affected the development of Greek mathematics, aspects of Chinese history might suggest the problem-based approach towards mathematics that was developed.

Plato believed and explained in Book VII of The Republic that mathematics was important in understanding and attaining the idea of good which is the ultimate objective of philosophy. Plato believed that arithmetic and geometry allowed the mind to reflect and thus come closer to the truth, and also that “ the true use of arithmetic” is in “ compelling the soul to reason about abstract number and repelling against the introduction of visible or tangible

objects into the argument."[7]It has thus been argued that Plato believed that the ultimate aim of philosophy was to " help the mind to understand and acquire the idea of good" and that mathematics was a tool that helped to achieve that end.

On the other hand, the Chinese clearly believed in the practical value of mathematics and a quick study of Chinese history revealed that mathematics was developed with practicality in mind. One clear example would be the earlier mentioned chapters of the Jiuzhang Suanshu on grain growing and taxation – with the Chinese placing great emphasis on the importance of proper governance, mathematics was developed in order to calculate optimal methods of fair governance.

The fact that the Chinese wrote mathematics with characters instead of alphabets would have also explained the need for them to discover the decimal system before other civilizations.[8]As mathematics was written with characters, the decimal system was invented to prevent the memorization of countless characters in order to recognize large numbers such as the date. With a decimal system, Chinese mathematics was thus able to gain an advantage over other civilizations in terms of the development of mathematics.

Furthermore, during the period of Chinese mathematical development before 100 BC, the Chinese were interested in the areas of astrology and had a need to construct the calendar. As a result, many of the works produced in that time were related to astrology such as the Zhoubi Suanjing which provided instructions on measuring the positions of heavenly bodies using

shadow gauges termed gnomons.[9]With the need to measure heights and distances that could not be measured directly (heights of structures or the distance of an island away from the mainland), the Chinese also developed their own variation of the Pythagoras theorem, which Liu Hui demonstrated in his Haidao Suanjing. As a result of some of the problems that the Chinese faced, we see the development of mathematics in China as a solution to some of these problems.

Taking into consideration these other factors, there is clearly a relationship between the physical and cultural factors affecting China and their development of mathematics. On the other hand, while geometry had its practical uses for the Greeks, their main purpose for the study of mathematics was for instruction and loftier ideals of perfecting their souls.

Concluding on the Extent of Influence on Mathematics

Having considered the factors both philosophical and practical that might have affected the development of mathematics, one can see the distinct similarities between the culture’s respective philosophy and how it has caused mathematics to develop.

Ancient Greek mathematics developed in a manner that sought to separate concept from object, as could be inferred from their development of generalized mathematical theories in geometry (concept) discerned from postulates (object) since these postulates were observable truths such as “ All right angles are congruent”. At the same time, the philosophy of the Greeks had similar objectives as could be seen from the above mentioned Forms and quintessential substances that the Greeks believed in.

On the other hand, Chinese mathematics followed similar trends to that of their philosophy. With a focus on concrete examples and using analogies to solve other problems, the Chinese were clearly more concerned with matters of reality and had a pragmatic approach towards mathematics. Philosophically, there is a similar trend of practicality with the Chinese exploring the duties and proper etiquette of what they believed to be the " perfect man".

Again, the lack of credible literature seemingly undermines the entire relationship, yet it would be foolish to simply discount the fact that both philosophy and mathematics take on a similar direction in terms of development.

Thus in conclusion, one could easily argue that the method by which philosophy was approached has been similar to that of the way mathematics was developed.

Relevance to Modern Mathematicians?

Truth and Mathematical Certainty?

Having affirmed the relationship between philosophy and mathematics, we begin to question the relevance of such a relationship to modern mathematicians. One of the greatest questions of mathematics is its relevance to truth, and how mathematical inquiry may lead to certainty and truth.

Before we begin to explore the question of which mathematics (Greek or Chinese) was closer to mathematical certainty and thus truth, we must keep

in mind that Greek and Chinese mathematics were radically different in terms of method as was previously shown.

Based on those methods, we can categorize the mathematics according to the theories of truth that they appear to abide by. The Chinese appeared to base their system on the modern theory of truth that is pragmatism. According to the theory in a simplified form, a concept may be considered true if it is directly relevant to reality. This meant that a concept would be true if it had any practical consequence and was thus judged based on its practical value. Pragmatism is thus highly pertinent to the method of Chinese mathematics, which was in essence a study of the practical effects of theories of mathematics.

On the other hand, the Greek method appears to follow the theory of coherentism, which in simple terms was the theory that the truth of a system of beliefs could be determined based on how well it coheres with other systems of belief. This seems to be applicable to the Greek method of approaching mathematics, where axioms were the basic beliefs and entire systems (theorems) would be developed from these axioms. The truth of these systems would then be appraised according to how well they cohered with the basic sets of beliefs. One might argue that foundationalism would have been a more applicable theory to the Greek method, yet the Greeks did not simply base their theorems on noninferential knowledge such as axioms, and instead used postulates (inferential knowledge) in geometry. As a result, the axiomatic method of the Greeks would have appertained to the theory of coherentism.

It is important to note that despite these theories of truth being modern, the concept behind method of mathematics and theory of truth appear to be similar, and would thus be applicable in the exploration of mathematical certainty.

Who was more Certain?

Having ascribed to Greek and Chinese mathematics coherentism and pragmatism respectively, the question of who was closer to mathematical certainty becomes apparent. Both schools clearly had their strengths and weaknesses in such a comparison, with the Chinese being directly relevant to reality and thus closer to certainty in terms of practicality. On the other hand, the Greeks would have believed that they were aspiring towards certainty through the separation of concept from object (abstraction), where truth in the complete discovery of all Forms would have been certainty.

Given the extent of influence on modern mathematics that Greek mathematics has, one would easily consider the adopted Greek mathematics as “ more certain”. Yet the idea of complete mathematical certainty seems to be impossible, as proved by Kurt Godel with his theorems that “ a system is either complete or consistent” and thus “ impossible…to fully “ prove” any proposition.”[10]The ramifications thus being that certainty is impossible to achieve, and that in terms of the axiomatic method, mathematical certainty can never be fully arrived at.

Furthermore, the existence of various theories of truth might already suggest that there is a lack of existence of complete certainty, and this thus suggests the probability of the quest for mathematical certainty being futile.