TOK Prescribed Title

“Robust knowledge requires both consensus and disagreement.” Discuss this claim with reference to two areas of knowledge.

Candidate number: [redacted]

Word Count: 1600

This claim makes an important distinction between knowledge and robust knowledge. It only refers to robust knowledge and absolutely states that robust knowledge cannot be generated without consensus and disagreement. This led me to wonder: *what is robust knowledge? How is the robust knowledge generation process different from the knowledge generation process?* It seems that by definition, all areas of knowledge (AOKs) have consensus regarding the method of inquiry experts follow to generate knowledge. For example, science is science because scientists use the scientific method. Additionally, consensus is present when experts in a particular AOK come to the same conclusion, while disagreement may mean they come to different conclusions. Disagreement may be required in some AOKs to promote further investigation to find evidence to support an established theory or support creating a new theory. Eventually, experts must agree on theories to produce shared knowledge. Ultimately, robust knowledge is generated if an AOK's shared knowledge maintains its validity even when scrutinized by experts within the AOK and is resistant to revision stemming from new research findings. Thus, robust knowledge does indeed require consensus and disagreement.

Mathematics is an AOK which produces knowledge that deals with "quantity, shape, space, and change" (IBO). Spoken languages and cultural context are not integral parts of generating mathematical knowledge because the numbers and other symbols in mathematics were consensually created to remove human agency from interfering with the seeming universality of the culture- and time-transcending knowledge produced by mathematics. This universality of mathematics proves useful when applying it to the natural and human sciences, who base their models and experiments off of mathematical knowledge. Nonetheless, at its core, mathematics employs a set of axioms (and accepted definitions/properties) which mathematicians assume to be true and agree upon. Mathematicians then use "pure reason" from these axioms to prove theorems (IBO). When a theorem is proved to be true using these universally accepted axioms, it is never disproven because a mathematical statement is true when it is proved, even in the natural sciences.

However, disagreement may exist in the way a mathematician proves a theorem. For example, Fermat's Last Theorem was the subject of controversy when Fermat claimed he proved that $x^n + y^n = z^n$ "has no integer solutions for $n > 2$and $x, y, z \neq 0$" but no such proof was found (Weisstein). For the next several centuries, mathematicians had unsuccessfully attempted to prove that statement through various ways until Andrew Wiles proved it in 1995 (Weisstein). Though there was consensus in the actual statement, disagreement was present in the proving process. Now, Fermat's Last Theorem can be considered robust knowledge in the mathematics AOK because it has been proved true for *all* cases of n. It can be argued that the Theorem was non-robust knowledge when mathematicians proved it true for certain cases of $n$because though it was valid knowledge generated through the methodology of rigorous proof of the mathematics AOK, it was not resistant to change when new research findings, i.e. new proofs, surfaced due to scrutiny from other mathematicians. Thus, in this case we can see where consensus and disagreement were both required to produce robust knowledge.

When applying mathematical knowledge to the real-world, there is often more disagreement than consensus. For example, a team-based project in our TOK class involved building a mathematical model to determine an article's accuracy. Initially, my team-members and I disagreed over the variables important to article accuracy and how to operationalize them. However, once the variables and their supposed interrelationships were established, the mathematics applied to represent that was simple to agree upon.

For example, we decided that the final article accuracy score would be an arithmetic mean of several subscores. This was easily represented by: $\frac{\Sigma \quad subscores}{n}$ where n represents the number of subscores. Our model produces robust mathematical knowledge because the process of analyzing articles to determine their accuracy scores and the mathematical equations are the same for *all* cases. However, while the internal mathematics of the model are certain, the extent to which the model itself accurately reflects the underlying reality is uncertain. This adds an additional layer of disagreement regarding the application of mathematical knowledge to the real-world. It can be concluded that the mathematics AOK generates robust knowledge when it uses the axioms created from universal consensus by mathematicians, though theorems may require disagreement to spur further research through which mathematicians creatively apply different reasons to prove them true. Therefore, cases where both consensus and disagreement are used tend to result in the creation of more robust knowledge than non-robust knowledge.

In contrast with the universal certainty of mathematical robust knowledge, the history AOK studies the recorded past to produce knowledge that may be unique to a particular culture so that it helps produce a sense of "common heritage" (IBO). Additionally, studying the past helps in dealing with future problems because it offers some precedent to build off of.

The historian searches for primary documents which share first-hand information about events that happened. Though one can doubt the reliability of these documents, if a vast number of documents present an event in a certain way, then the historian can confidently create a plausible theory which explains/interprets the event in that way. Importantly, there can hardly ever be historical "laws", i.e. historical statements that are true and can be proven. This is because unlike mathematics with its rigorous proof-process that will only label a statement as true if and only if it is true in all cases, historians may find documents that contradict their theory and offer another plausible explanation and interpretation of the events that occurred. Thus, a historical "law" cannot be established because differing points of view offer different interpretations and one theory cannot account for nor explain all cases.

Whereas mathematics requires consensus to generate robust knowledge, history requires disagreement to generate robust knowledge. Multiple historical theories which interpret a similar set of events can be considered robust knowledge when they are backed by a myriad of documentary evidence which explains/interprets events that are valuable to a particular culture. This shows how the sociocultural environment at the time the historian is researching influences the robustness of knowledge, and how consensus is required to generate robust knowledge.

For example, when researching bargadars (sharecroppers) around 1950s-1970s for my Extended Essay, I found all their testimonies included in my source pointing to their maltreatment by their landlords, who take more than their fair share of the produced crops. This abundant evidence clearly supports the theory that detrimental effects will follow the seizure of the bargadars' legally entitled share of crops by the landlords. However, other evidence I discovered laid the foundation for another theory—because less crops were available (due to their seizure by the landlords), the price of the crops increased due to the laws of supply and demand in economics, and thus, had a more positive effect on the bargadars as they were able to sell their fewer crops for higher prices. There was consensus present in the testimony of numerous bargadars which led to a strongly supported theory. However, the alternative theory, brought about by disagreement/contrasting facts, is also valuable to the bargadars and those studying them because it provides another perspective on the issue.

Both of these produced theories are examples of robust knowledge because they were created with the support of existing evidence and shed light into examining the recorded past of a particular culture. Another example of how competing theories produce robust historical knowledge can be seen in the actions of the U.S. in the Spanish-American War. Sensationalist newspapers from the time and interviews led older historians to theorize that the war was orchestrated to give Cubans more political freedom. However, later research uncovered the influence of large U.S. agricultural companies on the government, which declared war to gain land for growing more cash crops like sugarcane. This additional theory increases the robustness of knowledge because a complex event like the Spanish-American War can now be explained in another plausible way.

Though new research findings may lead to the creation of an opposing theory, the original theory is not discredited due to the prior evidence which led to the formation of that theory. Consensus is necessary for robust historical knowledge in terms of historians agreeing on the evidence's validity/reliability, and then disagreement is necessary to search for opposing evidence to create another theory alternatively explaining events. Together, consensus and disagreement produce robust historical knowledge by creating an initial theory from agreed-upon reliable evidence and then creating additional theories to offer different perspectives on a topic.

In retrospect, robust knowledge requires both consensus and disagreement. Without agreeing upon the AOK's methodology and certain conclusions, shared knowledge cannot be produced. Additionally, theories/laws/facts must eventually be accepted by most experts to gain credibility and eventually become robust knowledge when it is resistant to revision from new research findings. However, disagreement is essential to encouraging research that looks for evidence against an established theory in an attempt to disprove it or find new evidence to create another theory. A particular fact or theory's uncertainty should not be confused with the produced knowledge's robustness because knowledge can be robust without having 100%

certainty. This is especially true for the AOKs which do not use mathematics as a foundation, like history. One cannot determine a mathematical metric of how certain historians are that their theory is true/robust. Rather, if their theories are resistant to revision from new research findings, then they are robust knowledge and both consensus and disagreement are necessary to generate this robust knowledge.

Works Cited

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Weisstein, Eric W. "Fermat's Last Theorem." MathWorld, Wolfram Research, Inc., mathworld.wolfram.com/FermatsLastTheorem.html.