"How can we know if knowledge is produced more through 'Passive Observation' or 'Active-Experiment ' within the Human and Natural-sciences under a Mathematical-Perspective?

2. "There are only 2 ways in which humankind can produce knowledge; through passive observation, or active experiment." To what extent do you agree with this statement?

At first, I felt enticed to the statement because of how it implied that anybody can produce knowledge. The statement itself mentions there only being 2 ways in which we can produce new knowledge; not resisting unconscious, inferred-perceptions ("Passive-Observation"); or the skeptic involvement in evoking expectations upon inducing changes in variables ("Active-Experiment").

Recently I was food-poisoned and decided to change my diet; so I went to a bookstore and was looking for a new recipe-book when I came across a guide to T'ai-Chi. In it was a very fascinating concept of 'balance' illustrated by the symbol of the 'Supreme Ultimate'. It depicts both 'Yin' and 'Yang' manifesting within a circle in a particularly give motion that is not still, yet is balanced maintaining balance, but before their introduction was a state of 'nothingness' known as 'Wu-Chi'. What really caught my interest was the pattern in the symbol because, believe it or not, I was researching bifurcation-theory applied to the mathematical study of dynamic-systems when investigating the nature of Fazey and Hardy's Multi-dimensional 'Catastrophe Model of Anxiety'[1]. According to 'Bifurcation Theory', the way one would describe this pattern is a change in topological structure that is sudden, abrupt, and unnaturally positive or negative. Leading on to how Fazey and Hardy developed their model for anxiety was actually due to how unrealistic the Inverted 'U' Hypothesis seemed to be in describing the decrease in athletic-performance after reaching optimum-levels of anxiety. Fazey and Hardy used a more dynamic system to portrait a proper view of how performance-levels plummet rather than decrease at a slow rate and created new knowledge in that field. My doubts gave rise, however, as to how this knowledge was 'produced'. Knowledge is not something that exists in the material-world (with physical-properties that allow us to perceive it) – it is more of an abstract concept. Yet it could be physically represented (e.g. bifurcations to represent the transition between states) through a Mathematical-perspective.

[1] Revision World, n.d. *Catastrophe Model.* [Online] Accessed February 13th, 2015. Available at: http://revisionworld.com/a2-level-level-revision/pe-physical-education/arousal/catastrophe-model.

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This lead me to think: "**How can we know if knowledge is produced more through 'Passive Observation' or 'Active-Experiment' within the Human and Natural-sciences under a Mathematical-Perspective[2]?**

When Looking at the Scientific-Method, we see many 'steps' that, when followed, are known to lead to new knowledge as demonstrated by Fazey and Hardy. One can see this to be like a set of dominos, creating a 'knock-on' effect just as some steps in the 'scientific-method' involve 'passive-observation' as another would use 'active-experiment'. Through this analogy, the production of knowledge is seen to be using 1 method at a time.

Teman Cooke argues, however, that the 'Scientific-Method' be revoked for its own inaccuracy of depicting 'how' the process of producing new knowledge in science actually happens in truth[3]. At the moment, 'Science' is taking what is actually known to happen and describes the process in a way that it is not; that there is an end to the problem, when there really isn't . This gave rise to the 'Cycle of Scientific-Thinking'; and can be similarly seen by how Piaget[4] describes children as "little scientists" who continuously engage and interact with the world around them to produce new schemata by either the process of 'assimilation' or 'accommodation'. This process eventually decreases so much over time that it barely happens as we would have an exceptional amount of knowledge, though still happens because of 'how' we have decided categorized the knowledge we produced; as an example, Pluto being classified as a planet at first was new knowledge that sought to have reached an end because, according to the scientific method, once a conclusion has been reached, it is left at that.

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[2] Dombrowsli, E., Rotenberg, L. & Beck, M., 2013. *IB Diploma Programme; Theory of Knowledge Course Companion.* New York: Oxford University Press. P. 216

[3] TEDxLancaster, 2014. *The scientific method is crap: Teman Cooke at TEDxLancaster.* [Online] Available at: https://www.youtube.com/watch?v=j12BBcKSgEQ [Accessed March 2nd, 2015].

[4] Crane, J. & Hannibal, J., 2009. *IB Diploma Programme; Psychology Course Companion.* New York: Oxford University Press. [Accessed March 2nd, 2015]

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Should that have been the case, there would still be a Pluto today. Instead, however, it was the trigger that lead to even more new knowledge about 'celestial-bodies', and the realization that Pluto is something other than a planet after noticing a problem in its categorization. as it is a cycle, it has no end and consists of specific stages different stages that encourage the expressed contribution in one method more than in another's. One can see this contribution as a percentage where the value expressed (x) is governed by the rule '0<x<1' (as 1/1=1 and 0/1=1); as '1' is a whole number and represents 100%, which is full-capacity (if expanded, it would remain to be known as 100%), this excludes the possibility of their ever being two methods used. If we have 0.4/1 this implies that in order to reach '1', 0.6/1 would also have to be expressed. Therefore, the two methods are used simultaneously with different values expressed with respect to the cycle's stage.

Since there are only 2 expressed-values mankind uses to produce new knowledge, a good example to demonstrate how knowledge is produced through a greater expression for the value of 'passive-observation' could be seen in how we categorize what we come across. Carl Linnaeus wanted to classify all the elements of the natural-world by developing his 'Species Plantarum' and 'Systema Naturae' and filling it in by gathering qualitative-data that could only be based on observations and quantifying it to attain certain 'themes'[5]. Likewise with 'active-experiment' being more expressed, an example to demonstrate is how the 'areas of knowledge' were constructed by using the 'ways of knowing' through different contexts.

Upon closer inspection, if passive-observation and active-experiment were to be divided and categorized, we would have 2 interactional-states as well as physical-interactions. It would seem that the interaction is dependent of the state; as if not, it implies that 'what' one does governs the interactional-state one is in, which is the equivalent to a reaction (where there is no control over how one thinks). 'Reactions' evoke only 1 action and so are seen as the opposite of 'interactions' because of how 'interactions' are continuous

[5] Dombrowsli, E., Rotenberg, L. & Beck, M., 2013. *IB Diploma Programme; Theory of Knowledge Course Companion.* New York: Oxford University Press. P. 212

reactions (like a cycle). Saying that the interactional-state in which one is in would determine how something is done later on would be true by logic. So then human-kind has not only produced knowledge through passive observations, but through passive-experiment as well.

Piaget has the genetical-epistemological notion that children are biologically programmed to interact with the world – which I agree with, seeing as how humans grow and develop 'curiosity'- but given the fact that we have a brain and not be able to use it to think rationally sounds like a handicap. For children, their 'active-engagement' could very-well be described as 'passive-experiment' because they are doing what comes natural to them; reacting to their predetermined thought-patterns.

Looking back at Linnaeus, unfortunately, he had to revise it again and re-categorize the organisms more than once. As a result, added more plant and animal-species based on significant insight on important features. We can now also say that it is possible to recategorized current, existing-knowledge to create new knowledge (e.g. A whale is not a fish anymore, it is now known as a mammal) by also using 'active-observation'.

To conclude, I would say that I do not agree with the statement to a large extent. Throughout this essay, knowledge has been seen to be more 'found' than 'produced', giving the impression that it was always here.

Regarding my 'dominoes' example, or the 'Cycle of Scientific-Thinking', what I am not so certain about is 'how' the 'knock-on' effect even begun; The way this comes to be can be demonstrated by dividing 'zero' by 'zero'. Intuitively, one would think to get an undefined answer after having attempted this before. As one 'zero' in a single 'zero' suggests '0/0=1'; but given some rational thinking, we can never really reach the value of 'zero' because it represents an un-manifested state, and so we can only arrive to a value as close to 'zero' rather than the value itself – and so it would seem that because within '0.0000001>0' , no zero would fit (0/0.0000001=0). Following this kind of logic, though, would suggest that there are zero 'zeros' in a 'zero' (0/0=0). Both '0/0=1' and '0/0=0' are mathematically valid; which is why it is deemed 'undefined'. However, given

that we have the factorial for '0' ('0!'), then '0!=1'. This shows that 'zero' is not 'nothingness' and that there was always 'something' in the same way knowledge was never not present as it was always here because, according to mathematics, '1' is the product of something .

Allow the explanation for the phenomenon be done by using 'chaos theory'. Chaos theory is a sudden, unnatural, shift in a pattern and can be described by Feigenbaum as having "to change gears"[6]. This has resulted in a new way of seeing patterns in a far more complex way[7]. This, along with the development of the computer, gave-way to a very sensitive view of how minute changes in variables, such as the beating wings of a butterfly in one part of the world, can affect major outcomes over time; like the formation of a hurricane in another part of the world. Lorenz described this to be the 'Butterfly Effect'[8]; a continuous 'knock-on' effect, indeed.

[Word-count: 1595]

[6] Gleick, J. 1987. *A Geometry of Nature, Chaos: Making A New Science*. Accessed March 2nd, 2015. London. Penguin Books. P 185

[7] Gleick, J. 1987. *A Geometry of Nature, Chaos: Making A New Science*. Accessed March 2nd, 2015. London. Penguin Books. P 94

[8] Dombrowsli, E., Rotenberg, L. & Beck, M., 2013. *IB Diploma Programme; Theory of Knowledge Course Companion.* New York: Oxford University Press. P. 348