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STS
Encounters

Research papers from DASTS

Volume 15 • Issue 2 • 2023

The Benefit of the Doubt: Rethinking critique in/of scientific knowledge

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STS Encounters is published by the Danish Association for Science and Technology Studies (DASTS). The aim of the journal is to publish high quality STS research, support collaboration in the Danish STS community and contribute to the recognition of Danish STS nationally and internationally.



www.dasts.dk

ISSN: 1904-4372

The Benefit of the Doubt: Rethinking critique in/of scientific knowledge

Marie Larsen Ryberg

Abstract

The relation between critique and scientific knowledge has become a perilous conundrum. The precarity of this relation is conspicuous in recent 'post-truth' dynamics but also in the field of Science and Technology Studies, where established critical approaches to scientific knowledge have been subjected to devastating (self-)criticism. This article explores an aspect of critique often left unnoticed, namely that of doubt, asking whether it might provide a pathway for rethinking scientific reasoning and critical thinking. Drawing on ethnographic studies of a university-wide initiative to promote the integration of research and teaching, the article considers how students and researchers tackle doubt in teaching that involves scientific inquiry and research. Contemplating what has been termed the positivity of doubt in American pragmatism, and its recent developments in French pragmatism, the paper considers the implications of the role of doubt in scientific inquiry for how we might approach the cultivation of critique in and of scientific knowledge today.

Keywords

Doubt, critique, science education, research-based teaching, American pragmatism, French pragmatic sociology

Introduction

The relation between critique and scientific knowledge has become a contentious issue. In the current context of 'post-truth' dynamics, scientific knowledge has increasingly become the subject of public

doubt and critique, in ways that were previously unimaginable. Studies of the politics of science have demonstrated how critique and doubt can be harnessed to mislead the public, leading to heightened concerns about issues of ethics and trustworthiness (cf. Oreskes & Comway, 2012; Oreskes, 2021; Melo-Martín & Intemann, 2018). Within the field of Science and Technology Studies, this precarious dynamic of the critique of science has sparked a discussion of the established critical approaches to scientific knowledge within the field. In some cases, this has led to devastating (self-)criticism (cf. Jasanoff & Sinnett, 2017; Latour 2004, Sismondo, 2017; Fuller, 2017). These tendencies raise questions about the role of doubt and critique in relation to scientific knowledge, both in STS and beyond.

In the field of STS, the intersection of science and critique has traditionally underpinned the approach to scientific knowledge making. By analyzing scientific controversies, the politics of artefacts, or the role of nonhuman actors, STS scholars have introduced critical angles to the analysis of science and technology, at times creating 'scandal' both inside and outside the field (Jasanoff, 2017, p.178; Winner, 1980; Collins & Yearley, 1992, Stengers 2000, p.3). However, the role of doubt and critique in how science is pursued and handled has received comparatively less attention.

This article examines the role of doubt in processes of scientific reasoning and research. Drawing upon a series of observations made during university courses where faculty members experimented with integrating research in teaching, I have noted that while both students and faculty expressed excitement and inspiration, the students also exhibited reactions that appeared to convey uncertainty and doubt.

Considering these moments of doubt, this article explores the role of doubt and its relation to critique in processes of scientific inquiry and research. My starting point is what French philosopher Albert Ogien has called 'the positivity of doubt' in his characterization of American pragmatism (Ogien, 2014, p.424). The idea is that for American pragmatic thinkers, doubt was seen a key aspect of a scientific process – doubt plays a positive role. While my title is playing with the

expression to give someone “the benefit of the doubt”, my intention is thus somewhat different as I want to show that doubt may indeed be beneficial.

To make this case, I will delve into the role of doubt with respect to scientific reasoning in the works of philosophers Charles Sanders Peirce and John Dewey. In addition, I will also draw upon more recent work on doubt and critique put forth by French pragmatic sociologist Laurent Thévenot. I will argue that a renewed concern with doubt in processes of scientific knowledge making and science education presents a possibility for cultivating novel realizations and engendering situated forms of critique. I maintain that making a place for doubt in scientific inquiries is where the potential benefits lie.

The material for this analysis has been gathered as part of a research project that explores the relation between research and teaching at the university, and its current re-inventions. This research project takes its starting point in a strategic initiative at the University of Copenhagen to develop the integration of research and teaching. Combining participant observation, interviews and historical approaches, the project examines the different conditions and modes of organizing that affect how such integration takes form in the experiments within this project.

More specifically, I conducted ethnographic fieldwork in 7 of 54 courses that experimented with integrating research and teaching in this initiative between 2020 and 2023. These courses were led by members of faculty who had applied for and received small funds to offer a course and experiment with integrating research and teaching. In most cases, this involved students working with topics overlapping with faculty members’ research and addressed open questions, and in all cases, students used research methods. I was allowed, and in some cases even invited by teachers, to follow and document the process. The faculty members and students I interviewed provided oral consent in observation situations, and in formal interview situations, they provided written consent. The material further consists of interviews with students and researchers/teachers from these seven and ten additional courses across the university. It also includes all written

reports from faculty members on the experiments and participant-observation in two knowledge-sharing workshops. In addition, questions were informed by interviews and analyses on the policies, public and educational debates surrounding the notion of research-based education in Denmark since 1990.

Throughout this research, one noteworthy observation has been the pervasive atmosphere of inspiration and enthusiasm that characterizes courses integrating research in teaching. In ethnographic interviews, the majority of students expressed the view that the courses were among the best they had ever taken, and in formal interviews, many emphasized that they had never learned in such an engaging manner before. However, despite this generally positive sentiment, a significant proportion of students, across a range of diverse courses, expressed doubts, uncertainties, and perplexity at various points during the course. To illustrate, let me provide an example.

Doubt in action: “This is what research is like”

In a teaching laboratory on the second floor of a concrete building at the University of Copenhagen, 15 masters’ students are in their third week of a 7-week course on Protein Science. The course is a practical explorative lab-based course focusing on a group of proteins called intrinsically disordered proteins. The professor teaching the course jokingly calls herself Dr. Chaos, making a parallel to the proteins under scrutiny. These kinds of proteins are largely unexamined despite making up more than 30-40 % of the human genome. Dr. Chaos highlights that these proteins behave unexpectedly, and their reactions cannot be predicted solely by their form, which necessitates a different approach to teaching. In contrast to traditional lab courses, where students follow a strict protocol and recipe with defined outcomes, this course is structured as a practical exploration with no textbooks, recipes, or exams. Instead, students spend three full days each week for five weeks in the lab exploring various types and aspects of intrinsically disordered proteins.

In the early stages of the course, the students divide into groups and select the protein they find most intriguing from a list of proteins that are largely unexplored. Over the following weeks, the groups undertake various experiments to study the protein's properties, behavior, and forms. By the second week, the students begin searching for existing research on their selected protein, while simultaneously purifying it from the given sample.

One morning in the second week, Dr. Chaos and I enter the lab, and the room is abuzz with activity. The students swarm around the professor, seeking guidance on their next steps. Suddenly, one student throws herself onto the floor. While her movements are measured, it is an unexpected sight in the formal laboratory setting. According to two members of her group, their experiment has failed, and they cannot detect their protein in the test they conducted. Dr. Chaos attempts to comfort them, stating, "This is what research is like. Let's examine what this could imply" (September 2021, *my translation*). When I follow up with the group later, they explain that these unexpected results provide insight into the shape of their protein.

In the afternoon, I engage in conversation with two students from the group over daily cake served on a small table in the hallway outside of the lab. They just returned from the basement, where the department houses a large magnet, mapping out how the nuclei of their protein behaves. I ask how it is going, to which one of the students says he has never been this nervous, not even during exams. As he stands, composure intact, holding a cake in his hand, I am uncertain if he is jesting. Later, during an interview with the entire group three months after they have completed the course, I revisit this episode. They chuckle and cannot recollect the situation but instead assert, "Yeah, we really learned something about what research is like" (March 2022, *my translation*).

While this is perhaps one of the most explicit expressions of students' doubts in courses integrating research in teaching, I have observed many more subtle, often merely bodily, reactions that seem to indicate similar emotional expressions of being uncertain or doubtful.

Halfway through the course, I share with Dr. Chaos my observation that students' doubts are more at play in research-oriented courses. She responds candidly:

You know what, I am also doubtful. I not sure whether they will make it. Will they all be able to find out something new and present it at the end of the course? I too am in doubt here. (September 2021, *my translation*)

For Dr. Chaos, the excitement of research lies in not yet knowing, she says, and this is also what she wants students to experience. In lab teaching, she seeks to instill this in her students, asking them questions instead of providing answers. Dr. Chaos finds that students should through the process of arriving at the answers on their own. Doubt, according to her, is a fundamental aspect of her course and of students' learning to do research.

Dr. Chaos's approach to dealing with situations of not knowing and doubt appears to affect her students. During a subsequent presentation on the course, one student recounts that the experience involved transforming frustrations into "spontaneous ideas" instead of succumbing to doubtfulness. For the student, this felt like "being part of something meaningful" (January 2022, *my translation*).

These examples of students' doubtful moments doing research call for reflection on whether we are giving enough consideration to doubt in our approach to scientific knowledge today. Moreover, in a time when the relationship between critique and scientific knowledge has become precarious in new ways, these instances raise a broader range of questions about the potential benefits of doubt in scientific reasoning and critical thinking. It is therefore important to take a step back and examine the concept of doubt and its possible links to scientific thinking and critique.

Doubt and its role in science for Peirce and Dewey

The concept of doubt has a rich philosophical and religious history. It can be defined as “a feeling of uncertainty or lack of conviction”, thus expressing an individual's lack of belief or trust (Oxford Dictionary of English, 2015). The word doubt derives from Old French “doute”, from Latin “dubitare”, which means to hesitate (ibid.), indicating that doubt also has a temporal meaning, involving a delay in acting. Being doubtful is not about being resolute or hasty but involves the undecided and slow. Doubt is also closely related to despair. In both French “crainte” and Danish “fortvivelse”, there is a fine line between being doubtful and falling into despair¹.

The notion of doubt also plays a pivotal role in the discourse surrounding scientific reasoning in the late 19th century, as well as in the efforts to establish a democratic public through education in the early decades of the 20th century, wherein doubt was regarded as a constructive force. The American pragmatist philosopher Charles Sanders Peirce, in his influential 1877 paper, “The Fixation of Belief,” described doubt as a critical catalyst for changing an established belief. In this sense, Peirce regarded doubt as a prerequisite for what he called the scientific method, where you fix a belief by putting it to the test. “The irritation of doubt causes a struggle to attain a state of belief. I shall term this struggle inquiry,” Peirce stated (Peirce 1991 [1877], p.150). This irritation, according to Peirce, is a positive thing, as it causes a struggle – what Peirce calls an “inquiry” – to get back into the peaceful state of having a settled, fixed belief. For reaching a new conclusion. Indeed, for Peirce, the irritation of doubt is an essential component of the scientific method: “the irritation of doubt is the only immediate motive for the struggle to attain belief” (Peirce 1991 [1877], p.150). Doubt is what drives scientific inquiry.

Peirce's conception of doubt is rooted in the individual subject and does not fully account for the larger scientific process. Nonetheless,

his point about the role of doubt in scientific inquiry may still have something to offer, particularly when we are concerned with scientific reasoning and critical thinking. For American pragmatist John Dewey, who studied with Peirce, the idea about doubt as driving inquiry became pivotal for how he viewed education. Indeed, Dewey turned this idea into a program for organizing education to foster a form of critical reflection in the pupils in ways he found were necessary for a democracy (eg. Dewey, 1915, 1916).

Following Peirce's basic idea that scientific inquiry starts in doubt, Dewey organized the laboratory school at the University of Chicago around the pupils' independent work with a problem to develop their “reflective attention” (Dewey, 1915, p. 151). Indeed, the idea that doubt is a starting point for scientific inquiry and reflection runs through most of Dewey's work, appearing also in his seminal philosophic work, *Logic: The Theory of Inquiry*, (2013 [1938], p.18). In this book, he pointed to the influence of Peirce on these ideas, emphasizing that it enveloped Peirce's point that theories should make place for later discoveries, “leaving room for the modifications that cannot be foreseen” (Dewey, 2013 [1938], p.41).

Dewey's influential book *How we Think* from 1910 is the most elaborate on the issue of doubt. In this book, Dewey argued that doubt constitutes the first of what he saw as two basic elements of reflective thinking, namely “(a) a state of perplexity, hesitation, doubt; and (b) an act of search of investigation directed toward bringing to light further facts which serve to corroborate or to nullify the suggested belief.” (Dewey, 1910, p.6). Dewey even argued that “the essentials of thinking” are “to maintain the state of doubt and to carry on systematic and protracted inquiry” (Dewey, 1910, p. 6; cf. 1915, p.150). For Dewey, linking doubt to the process of inquiry is thus where the benefits lie.

Dewey marked out this link between doubt and inquiry in his description of a five-step process of thinking, starting by a “felt difficulty” and ending by a conclusion accepting or rejecting a belief. These steps were:

1 CNRTL, 2022: Doute; Den danske Ordbog, 2022: Fortvivelse

(i) a felt difficulty; (ii) its location and definition; (iii) suggestion of possible solution; (iv) development by reasoning of the bearings of the suggestion; (v) further observation and experiment leading to its acceptance or rejection; that is, the conclusion of belief or disbelief. (Dewey, 1910, p.74)

This five-step model has been widely used in curriculum planning all over the world. It has been translated into a plethora of formats and five-steps models for problem-based teaching or inquiry-based learning. And Dewey's emphasis on Peirce's point on the need to make theories open to new discoveries was later echoed in discovery pedagogies and theories of scientific discovery (eg. Bruner, 1961). These ideas have, thus, been highly influential in teaching education and policies, circulating amongst other things through the movements *Nouvelle Education* in France and *Reform Pädagogik* in the German speaking areas (Ryberg et al., 2022). Doubt, however, seems somehow left behind in many of these translations.

There are, nonetheless, good reasons for a renewed concern with doubt in relation to scientific inquiry. Recognizing that doubt and uncertainty are integral components of the research process is key to tackling the emotional experience of doing research. Particularly in the context of student research, where the thin line between falling into doubt and despair versus making it a benefit for further inquiry can be challenging. As we could see in the example with Dr. Chaos, saying "this is what research is like", acknowledging the role of doubt and the still unknown as inherent to a research process has the potential of opening for further inquiry and new realizations. The benefits of doubt for research depend on how it is tackled.

Dewey's work is re-visited these years, and his model of and for scientific thinking has rightly been critiqued for assuming a linear historical development, placing Western science as the highest stage, whereas other cultural forms of knowledge were seen as somehow deficit, immature (cf. Fallace 2009). However, the concept of doubt does

not necessarily entail such a linear model but can also be part of a focus on plural forms of knowledge and a situated critique of human action. In fact, this is the concern of French pragmatic sociologist Laurent Thévenot in his work on the relationship between doubt and critique.

Doubt and the critique of action in Thévenot's pragmatist sociology

In contrast to Peirce and Dewey, Laurent Thévenot's focus is not on doubt as a precondition for scientific thinking, nor is he trapped in a view of a linear history of scientific progression. Instead, Thévenot examines doubt in relation to different forms of human action, which he refers to as plural *régimes* of engagement (Thévenot, 2011). Like Peirce and Dewey, Thévenot views doubt as linked to reflection and critique. However, for Thévenot, doubt is not primarily about establishing a new belief or developing a critical attitude. Instead, it is a momentary state of mind in which the individual becomes aware of the benefits and costs of acting and investing themselves in a certain way – of how they engage.

In Thévenot's work, doubt is a key point in stake in his theorizing about *régimes of engagements*. Thévenot's focus on *régimes* of engagement is rooted in his observation that individuals act differently in various situations (Thévenot, 2006). This concern arose from his unease with Bourdieu's conceptualization of individual action, which emphasized habitus and the actor's specific position in a field (Thévenot, 2005). Thévenot, who worked in Bourdieu's research group, found that this view of individual action was too narrowly focused on the actor's interests and competition in a particular field, and that it ignored the various ways in which an individual engages with the world in different situations, and shifts between different modes of engagement (Thévenot, 2011, p.42).

To unfold this dynamics Thévenot started developing a vocabulary of (now counting) four different basic forms characterizing how individuals engage, calling these *regimes of engagement* to draw attention

to the ways in which they are supported by a particular arrangement of an environment, specific devices and institutional formats (2014, p.248). These four ways are i) a regime of familiarity, ii) justification, iii) of planned action, and iv) of exploration (ibid.). What is noteworthy about this ambition is the concern with the ways in which one way of engaging guarantees a *good* – they mark a benefit for the individual that engages. For instance, this could be the pleasure of doing things in a familiar fashion, or of exploring and discovering something new (cf. 2013, p.247). Interestingly, Thévenot posits that there are two ways in which an individual can engage with each of these regimes of engagement: by blindly trusting in the benefits of acting in this way, or by paying attention to the sacrifices entailed in this way of acting (Thévenot, 2014, p.248):

In each regime, one can rely blindly (with one's eyes closed) on marks that one views as the most significant reference points for coordination. Yet, symmetrically to marking, engaging also involves the phase of doubting (having one's eyes opened) that is remarking and, thus noticing with renewed attention what one sacrifices, or fails to see, by "blindly" trusting in the given mark (Thévenot, 2014, p.248).

Doubt in Thévenot's theory of engagement, thus, is conceptualized as a matter of opening one's eyes to the consequences of engaging in one way, and not in another. Thévenot's point is that sometimes an individual opens their eyes and see what they sacrifice by engaging in a particular way. This could be a situation of working with standards, or being explorative, or doing things in a familiar, rather than a new way (cf. Thévenot 2009, 2011, p.60). For the regime of *planned action*, for example, such doubt involves opening the eyes to "what one sacrifices by focusing on functionalities and outputs and on the ongoing revisions needed to carry out the plan" (2014:250). In relation to the *familiar engagement*, doubting involves distancing oneself from engaging in a

way that makes one "feel at ease." (ibid.) Thus, in the moment of doubt, the individual is no longer acting in blind faith but realizes the benefits associated with this way of engaging but also to what is sacrificed. Paying attention to the moment of doubt, Thévenot thus wants to point to how the ways in how we act can be estranging and involve subtle forms of oppression:

... closing one's eyes when relying with blind faith on the marker of the guarantee; opening one's eyes to what is sacrificed. This twofold characterisation enables us to understand the reifying reductions of engagements and to unveil mechanisms through which devices contributing to assurance lead to abusive or oppressive power (Thévenot, 2011, p.36).

By pointing to the individual's potential for doubting their actions, Thévenot places the possibility for critique within the individual's intimate sphere. Critique may arise in moments when an individual opens their eyes to how an arrangement can support certain ways of acting, such as when online devices appeal to an explorative engagement in ways that continues to captive attention (Thévenot, 2014, p.258). Thévenot thus emphasizes that not only social scientists can engage in critique (2011, p.52). Rather, critique is a possibility for all individuals and involves doubting and opening the eyes to the mechanisms that can lead to abuse or oppressive power in relation to their actions (2011, p.54)²

The kind of critique Thévenot associates with doubting is not necessarily limited to the hands of the scientist or theorist, and it does not rely on existing categories such as class to address dynamics of misrecognition (Hansen, 2016, 2023). In this way, it diverges from the kind of critique proposed by Pierre Bourdieu, which works by

² For examples of analyses of how Thévenot's approach has been used to elucidate tensions between different forms of engagements in education, see for example Carlsen, 2021 and Dahmen, 2021.

debunking the reproduction of existing power structures. Instead, critique for Thévenot involves a subtle, often nonverbal activity in which the individual acknowledges the implications of acting in certain ways, and not in others (Thévenot 2014, p.250).

Thévenot's emphasis on doubt, thus, highlights a tacit and situated form of critique of the different ways in which the individual can realize and act on the power and oppression they experience. Opening the eyes does not require a verbalized statement of justification but may be a subtle and complex bodily and emotional experience and realization. An experience, which Thévenot notes, is however "inextricably linked to sociological issues around class, ethnicity, gender, age, and ability" (Thévenot 2014, p.259).

Rethinking critique in/of scientific knowledge: The two faces of students' doubts

Returning to the moments when students engage in research, we can begin to develop an understanding of what their expressions of doubt may entail, as well as their potential benefits. Firstly, with Peirce and Dewey in mind, such doubt is not necessarily unwanted, difficult, or unpleasant but rather can be viewed as a precondition for inquiry and for reaching a new understanding. However, doubt is often not accounted for in the way we organize our institutions of scientific knowledge production today. In higher education, research, teaching, and learning tend to prioritize the need for students and researchers to display results (cf. Brew, 2003; Rowlands & Wright, 2021). This dilemma was reflected in interviews with students who participated in courses integrating research. In these courses, several students reported that their engagement in the course was different from their typical approach, where they focused on planning their time in the most cost-efficient way. When asked about the difference between this course and other courses they attended, several students said they felt as though they were learning more and were less concerned with time and performing on exams. This difference made some students

realize the limitations of their usual approach. As one student put it:

If you are in it for the grade, the whole experience is different. Now, I have hurried [jabbet] through all the courses in my program. ...this whole process of learning has been destroyed [ødelagt] for me. I am tired of it having to move so fast, and you forget half of what you have learnt anyway. (July 2021, my translation)

These testimonies prompt us to consider whether educational programs are providing enough space for doubt, hesitation, and perplexity, and whether they are supporting students going through these processes. Making a place for doubt in higher education has the potential to move students away from engaging primarily with science as ready-made constructs and towards cultivating modes of thinking and doing that are sensitive to contingencies and unforeseen events. It offers an opportunity to engage with scientific facts not only as settled and pure knowledge to be memorized but also as something that should be critically assessed and related to the complex, situated contexts in which they emerge.

Developing a space for doubt, however, not only requires an environment that invites and accommodates students' doubt in dealing with scientific knowledge but also attention to the guidance needed to make doubt a positive force when dealing with scientific knowledge. The benefit of doubt does not occur automatically but rather requires care and explicit linkages to the process of scientific inquiry. It necessitates researchers and teachers, like Dr. Chaos, being willing to say, "This is what research is like."

On another note, with Thévenot in mind, we may begin to see doubt and critique as situated and closely related to human action. Thévenot's conceptualization of doubt in relation to different modes of engagement highlights that doubt and critique are not necessarily expressed through verbal actions but can also be subtle bodily and situated experiences of opening one's eyes to the implications of one's

engagement, as well as the oppressive aspects that may be inherent in such actions.

This approach to doubt offers a view of why students in the courses integrating research appeared to reflect doubt, uncertainty and perplexity, and still said they never learned so much. It allows us to understand how participating in these courses was for many students an experience of engaging differently in university teaching. The student who threw herself to the floor, and her group mate who claimed to have never been so nervous, are examples of the students' bodily and emotional experiences of engaging in research and realizing that it was different from their usual way of learning. Similarly, in the citation above, the student looking back on the ways her studies had been rushed and focused on getting a good grade, realized the sacrifices of the way she had invested in her studies. The arrangements of these courses as more open-ended research processes, thus, helped open students' eyes to the ways in which they were usually engaged in teaching, what the implications were and how it could be otherwise.

Thévenot's approach to doubt and critique as situated and bodily experiences, thus, allows for a view of the benefits of organizing courses or situations that invite for an alternative way of engaging. It shows that cultivating critique in and of scientific knowledge today, is not only a matter of making someone verbalize their own opinion, or justify a case. It can also be a matter of allowing for experiences that open someone's eyes to doing things otherwise.

In sum, we thus begin to see the benefits of both these two aspects of doubt at stake in students' reactions: Doubt is part of the process of scientific inquiry that makes students throw themselves to the floor or look worried because they engage in science in a different way. But this way of engaging also fosters a different sense of doubt, opening students' eyes to how they usually engage with science in teaching.

Conclusion: Re-vitalising doubt in and of scientific knowledge

The current perilous relation between critique and scientific knowledge calls for new approaches to addressing critique in science and technology studies (STS) and beyond. One possible pathway is to revitalize the somewhat neglected concept of doubt and to view it as an aspect of critique. In STS, as in education, the idea of doubt was somehow left behind, even if many early proponents of STS were founded in semiotics and pragmatist developments as seen in the work of Latour and Fabbri (1977). It seems the 1980s' interest in the technical and institutional character of scientific knowledge-making and critique of certain constructivist positions has displaced human experience from the equation. If notions of certainty and uncertainty, famously, have been considered in discussing the people's proximity to knowledge production and their confidence in technologies, doubt was off the radar (MacKenzie, 1993[1990], p.370ff). As a result, the temporal and emotional aspects of how individuals relate to science have been downplayed, as have the meanings of hesitation and despair, which are not only shaping the actions of the individuals engaged in scientific processes, but also currently playing an important role in public doubt and critique of scientific knowledge.

In sum, if the capacity for scientific reasoning and critique begins with the act of doubting, of opening one's eyes to the implications and sacrifices at stake in a given situation, then doubt demands renewed consideration. Rather than merely viewing doubt as an antidote to the scientific process, as something that must be fought (cf. Melo-Martín & Intemann, 2018), doubt could be considered as a starting point for further inquiry, discussion, and situated critique in the making, teaching and discussion of scientific knowledge.

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