

# Close Reading of Science Texts with Online Annotations

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## 1. Motivation

In the past, we have noticed that students have difficulties in accurately reading texts on physics that are not primarily related to research. However, the ability to read scientific texts is essential for scientific progress and positively affects writing skills.

## 2. Aim

We foster scientific literacy by training close reading prior to a writing assessment. To support students, we use online annotations, where annotations can be shared.

**Scientific literacy** involves the location and comprehension of scientific information, the adoption of a contemporary view of science, the development of informed conceptions, opinions, and beliefs, and the ability to communicate these ideas and persuade others of their veracity.[1]

**Close reading** involves “the mindful, disciplined reading of an object (i.e. text) with the view to a deeper understanding of its meaning”[2]. The main approach of close reading consists in determining which argumentative claims are the most important and how they fit together to support the author’s main ideas.

## 3. Instructional Setting

Within the undergraduate elective course “*Philosophical Reflections on ‘Physics II’*” we have introduced an extra four-week module focusing on close reading. Part of this module is a web annotation tool added to the instructional unit on close reading. Two texts from the philosophy of science were made available in the online annotation tool *hypothes.is* for training purposes.

During the first module, students got an online introduction to close reading and had to apply close reading to a selected text via *hypothes.is* (Fig 1). The task was kept rather simple in the way that students should identify problematic argumentative statements and explain their choice. In addition, students were invited to comment on annotations provided by other students. We repeated this procedure a couple of weeks later with a second close-reading text (Fig 2).

**Course description:** Accompanying the lecture course “*Physics II*”, this course critically evaluates topics and approaches from electro dynamics against a broader historical and philosophical/systematic background.

text highlighting

“There had always been a few spectral lines that could be regarded as shifted as much as Einstein required; all that was necessary to establish the red-shift prediction was a willingness to throw out most of the evidence and the ingenuity to contrive arguments that would justify doing so. The eclipse results gave solar spectroscopists the will. Before 1919 no one claimed to have obtained spectral shifts of the required size; but within a year of the announcement of the eclipse results several researchers reported finding the Einstein effect. The red shift was confirmed because reputable people agreed to throw out a good part of the observations. They did so in part because they believed the theory; and they believed the theory, again at least in part, because they believed the British eclipse expeditions had confirmed it. Now the eclipse expeditions confirmed the theory only if part of the observations were thrown out and the discrepancies in the remainder ignored...”[Earman and Glymour, 1980, p. 85]

Thus, Eddington and the Astronomer Royal did their own throwing out and ignoring of discrepancies, which in turn licensed another set of ignoring and throwing out of discrepancies, which led to conclusions about the red-shift that justified the first set of throwing out still further. What applies in the relationship in any two of these sets of observations applies, *a fortiori* to all the tests of relativity that were taking place around the same time. No test viewed on its own was decisive or clear cut, but taken together they acted as an overwhelming movement. This was the culture of science changed into what we now count as the truth about space, time and gravity. Compare this process with, say, political direction of scientific consensus from the center – which is close to what once happened in the Soviet Union – and it is admirably ‘scientific’, for the scientists enter freely into their consensual position, leaving only a small minority of those who will not agree. Compare it, however, to the idealized notion of scientific ‘method’ in which blind tests prevent the observer’s biases entering into the observations, and it is much more like politics.

We have no reason to think that relativity is anything but the truth – and a very beautiful, delightful and astonishing truth it is – but it is a truth which came into being as a result of decisions about how we should live our scientific lives, and how we should license our scientific observations; it was a truth brought about by agreement to agree about new things. It was not a truth forced on us by the inexorable logic of a set of crucial experiments.

Appendix to chapter 2 part 2

In history, as in science, facts do not speak for themselves – at least not exactly. The interpretation that Professors Earman and Glymour would put on their data might not entirely match the conclusion of this book. It is because Earman and Glymour cleave to rather different views of the nature of science than we do that we have been particularly careful to stay close to their account. We have popularized and clarified wherever we can but we have done our best to avoid any possibility of seeming to distort their material.

The section of this chapter which is most close to Earman and Glymour’s original starts at the sub-heading ‘The nature of the experiment’, and finishes around page 51 at the paragraph which ends with the sentence: ‘It appears, however, that at the time he was unable to educe any convincing evidence to show that this was the case’. In other places, other sources, and more of our own interpretation creep in.

It is, perhaps, only fair to Earman and Glymour to quote their own conclusion:

annotations

auf andere Theorien und vor allem genau Messresultate hätte auch den Fortschritt der Physik abbremsen können.

buchered 7 Apr

The red shift was confirmed because reputable people agreed to throw out a good part of the observations. ... More

So what we conclude is that peer pressure and consensus are powerful motivators even in science. Scientists, too, are only human. Perhaps requiring absolute integrity is asking too much of the successors of individuals whose survival depended for most of our history on fitting into the group. But hopefully we can, with time, grow in wisdom and integrity and allow the dogged pursuit of truth to replace our obsession with everything social, especially our need for consensus and fear of unfavorable judgment.

BZayton 6 Apr

We have no reason to think that relativity is anything but the truth – and a very beautiful, delightful and astonishing ... More

Einerseits erscheint zwar dieser Schluss nach der vorhergehenden Darstellung der Autoren einleuchtend, aber andererseits ignorieren die Autoren meiner Meinung nach die Tatsache, dass es es eben doch auch mathematische Gründe gab, die Relativitätstheorie zu akzeptieren, da diese (zumindest habe ich das schon öfter gehört) wohl auch mit Hilfe der Maxwell-Gleichungen hergeleitet werden kann. Außerdem bietet die Relativitätstheorie angeblich eine Brücke zwischen elektrischen und magnetischen Phänomenen, da man mit ihr zum Beispiel die Formel für die Lorentzkraft herleiten kann, ohne explizit irgendwelche Magnetismus zu “benutzen”. Dieser Aspekt der Rechtfertigung der Relativitätstheorie wird von den Autoren meines Erachtens weitestgehend vernachlässigt.

Hide replies (1)

- thomas97 7 Apr

It does mention where Einstein got his idea from. You are right, that they do not mention all the reasons why we believe Einstein’s theory to be correct, but that is not the message this article wants to send.

Figure 1: Online annotations with *hypothes.is* (screenshot).

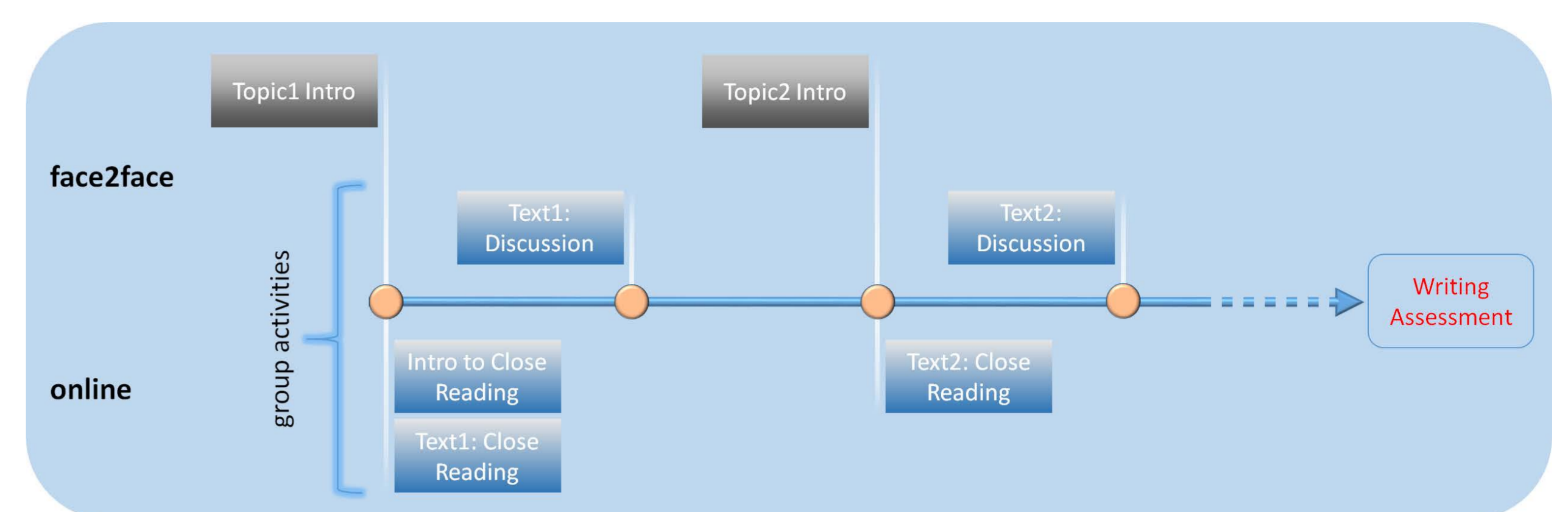


Figure 2: Close reading modules during the first 4 weeks of the course.

**Hypothes.is** (<https://hypothes.is>) is a free of charge annotation tool and offers an easy to use interface with flexible options for private, public and group annotations (Fig 1).

## 4. Acceptance and effects

29 out of 32 students made use of the annotation tool and submitted a total of 68 annotations plus 21 replies to existing annotations.

With an average count of 58 words, students provided a rather substantial body of annotations.

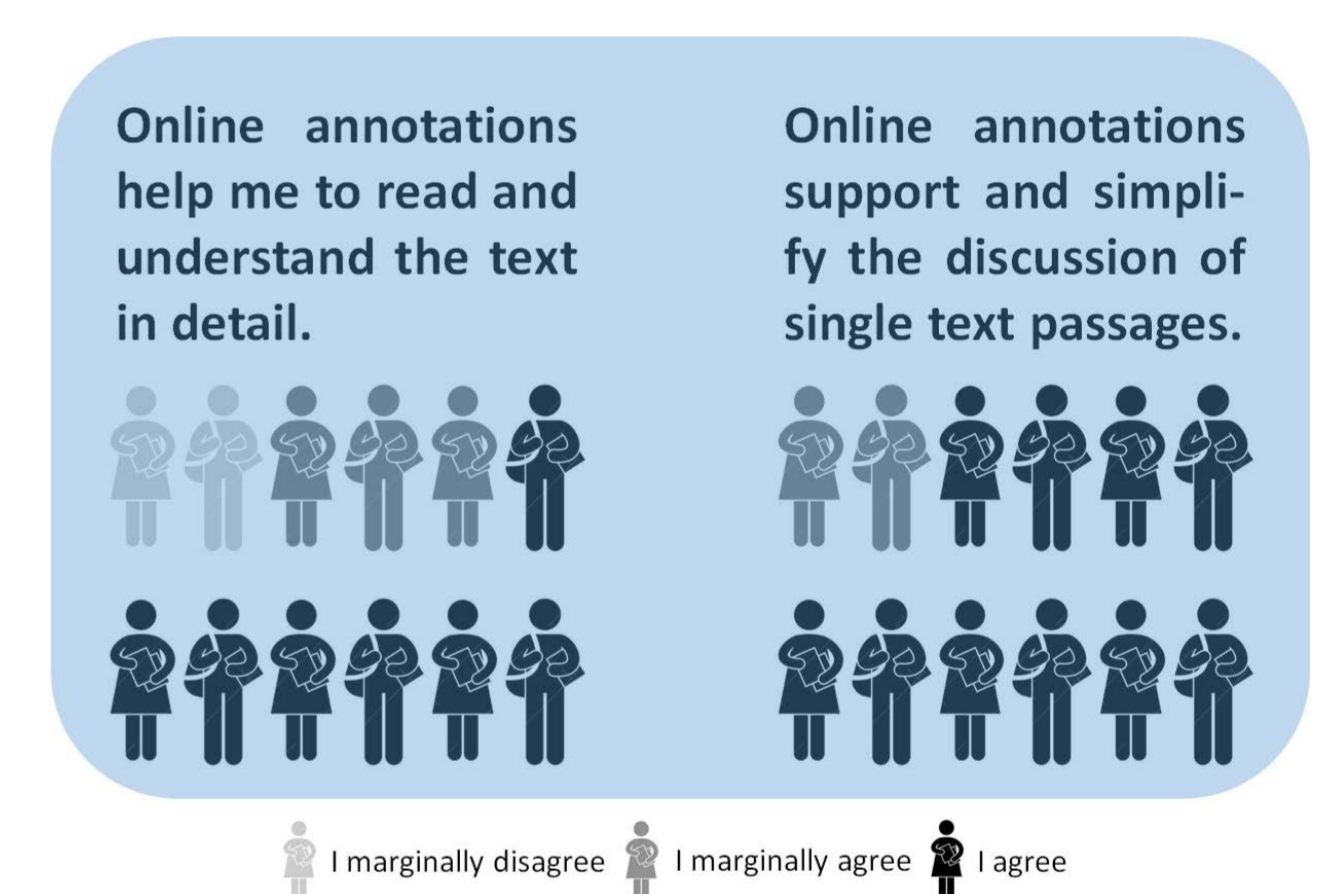


Figure 3: Student feedback.

Almost all students agreed that online annotations are helpful and simplify discussions related to texts (Fig 3).

The instructors noticed a considerable increase of the discussion quality as an indicator for increased reading skills. The quality and the grades of the writing assessment, however, did not improve significantly (Fig 4).

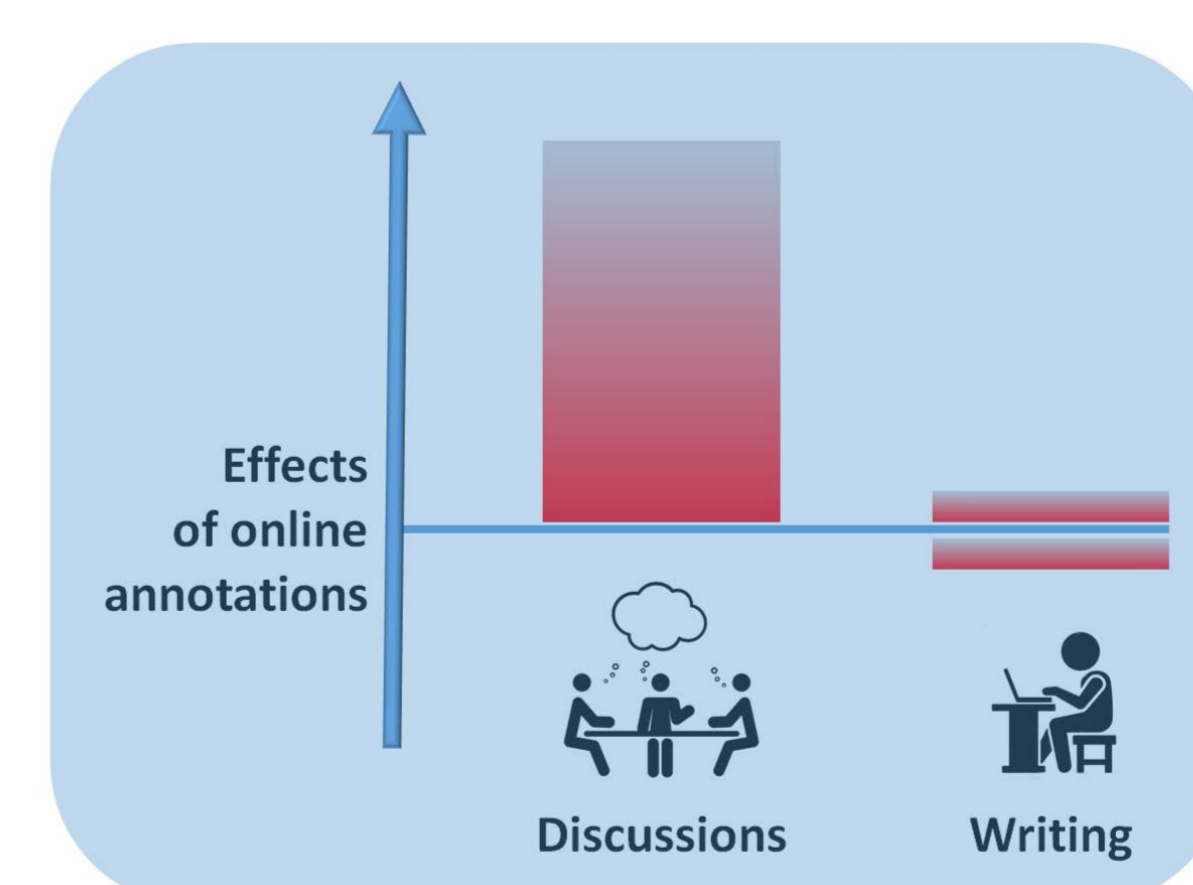


Figure 4: Effects.

## 5. Conclusion

Close reading with an online annotation tool looks promising. Students have adopted the tool and were able to meet the instructional goals at a very satisfying level. In the future, we are planning to extend the use of online annotations and to study the effects of online annotations linked to the improvement of writing in more detail.

## References

- [1] Holliday, WG, Yore, LD & Alvermann, DE. (1994). The reading–science learning–writing connection: breakthroughs, barriers and promises. *Journal of Research in Science Teaching*, 31(9): 877–893.
- [2] Brummett, B. (2010). *Techniques of close reading*. Thousand Oaks, CA: Sage.