Teaching and learning,
or
Learning and teaching

David Jefferies

Introduction

Publisher Jack Stone quoted Seneca the Younger in an editorial in the February edition of *antenneX* in his column "Stone's Throw"

"I am glad to learn, in order that I may teach"

It may well be that Seneca said this somewhere in his writings, but I have been unable to locate it in the original Latin although it can be found as a translated quotation in a few web sources.

This "quotation" set me off, and has resulted in this article, for I remembered a Seneca quotation rather differently. The reference I found was in Epistulae morales ad Lucilium - Liber I – 7 - 8

"Mutuo ista fiunt, et homines dum docent discunt."

or translating

"The process is mutual; and men, while they teach, learn."

and in its wider textual context

"Associate with those who will make a better man of you. Welcome those whom you yourself can improve. The process is mutual; for men learn while they teach."

This emphasis on the "mutuality" of teaching and learning seems to me to be quite right, and it provides the motivation to those of us who are academics. The idea behind the process of explaining oneself to students, or to colleagues, or in a seminar or conference venue, is that it sharpens up one's own ideas and fixes them more firmly in the memory. So we might say that the paraphrase

"I am glad to have the opportunity to teach, in order that I may learn the better."

more accurately represents why we engage with this hard and often repetitive activity.

Output information to understand it.

I return to the quotation I gave from Lewis Carroll in an earlier "from the shack" article this year

> "If possible, find some genial friend, who will read the book along with you, and will talk over the difficulties with you. *Talking* is a wonderful smoother-over of difficulties. When *I* come upon anything – in Logic or in any other hard subject – that entirely puzzles me, I find it a capital plan to talk it over, *aloud*, even when I am all alone. One can explain things so *clearly* to one's self! And then, you know, one is so *patient* with one's self; one *never* gets irritated at one's own stupidity!"

The solution to the "talking to oneself" problem is to fill the room with people, or with students. Contrariwise, the way to embed an idea in the student's mind is to get her/him to explain it to you (or indeed to colleagues or fellow students). For it is in "outputting" that the brain is best at "inputting". The essence of the tutorial system is that students bring along a piece of work and present it in real time to their tutor, who may make comments. The tutor's comments and views are rather unimportant in this process, although the remarks made often stick in the mind of the former student for a lifetime.

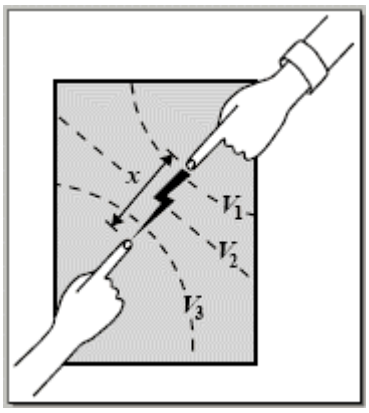
Small group teaching therefore involves people explaining difficult concepts to each other. After 43 years, I can still remember vividly the arguments I used about electromagnetic concepts and relativity in undergraduate tutorial sessions. And I can remember taking a lecture course on Group Theory in which each of the ten class members was assigned to give one of the lectures over the ten-week span of the course. I learned about "colour groups" which started off my interest in ferroelectric materials. For I had to work up enough knowledge and interest to explain, over 50 minutes, to my nine other student members. The academic sat in the back row offering visual encouragement from time to time.

In fact, this is the underpinning of the process of "peer review" for academic publishing. In a new research area one is not often appealing to an omniscient authority in letting one's work go to referees. Usually one finds that interesting a referee is a good way of ensuring a wider audience for one's work; if someone finds it worthwhile and interesting, then it is more likely that other folk will also.

Transmitting and receiving

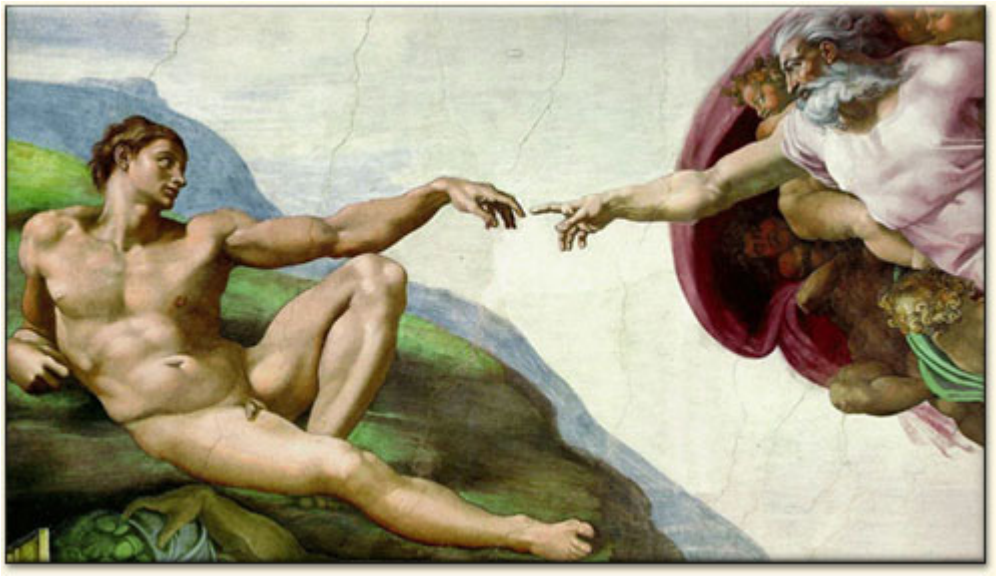
In the antennas game we are used to the idea of 'reciprocity". An antenna's properties don't in general depend on whether it is used in transmit or in receive mode. In teaching, it is easy to be typecast as an OOD (output only device). This is a common trap that some people fall into when they spend their life imparting information to others. Academics, Clergy, and Schoolmasters all are at risk from this syndrome. Reciprocity is important as a teaching quality.

Here is a logo adopted by the Physics teaching labs at Oxford University; it is an adaptation of a famous Michelangelo painting.



You can decide for yourself if there is any implied reciprocity in the connecting spark in this adaptation

Here is the Michelangelo original



Here it is suggested that the creation of Adam is represented as a unidirectional process.

One of the chief drawbacks of academic Journal publishing, or of writing a book "in a vacuum" without the constant monitoring of content by critical students, is that there is a very long delay between formulating the ideas and getting any reaction. The great majority of academic textbooks start out as a set of notes and problems for a University course, and the material is refined week by week by the critical eyes of the students who need to wrestle with the ideas and with the problems. In this case, the process of writing a textbook is not so far from small group teaching. On the other hand, the great majority of academic Journal articles have a very small readership, and of that small readership sample, even fewer people will ever offer any constructive criticism.

We might ask the collection of authors for *antenneX* online magazine to tell us how many communications they get from the large readership, where the communications offer constructive comment about the articles they wrote that have been published.

It seems to me that the motivation for the Antenna Discussion group is to provide an egalitarian forum where ideas, both traditional and also wild, can be kicked around in "protected public" without too much worry about "being shown to be wrong". After all, in Science the only authority providing an opinion of "wrongness" is the appeal to the experiment.

The process is necessarily inefficient. Many threads are followed which lead nowhere and which the more experienced contributors can see are a "waste of time and effort". But, hang on a moment; why is letting someone else approach a difficult subject in their own way a waste of effort? It isn't a waste for them. Much of the academic's job is to sit through repetitions of the same mistakes by many generations of students. Providing an ear, a nudge, and a gentle moderation is often all that is needed. Sometimes a student comes up with a novel insight, or has read around the subject in different sources and brings other ways of thinking to the attention of the tutor.

In all this activity, the tutor has another function. He or she is a node for information flow. Ideas that come in to the session are remembered, recycled, and tried on other students in another context. Thus, through the medium of the academic, the student has indirect access to the minds of many other people who have been in his situation before, without necessarily being able to discuss with them directly.

A former Oxford tutor remarked that he had taught a great many people during his lifetime, who were very much brighter than he was. He had listened to them and made his comments as described above, and when asked "how do you do it, then?" replied, "It is simple. It is all experience."

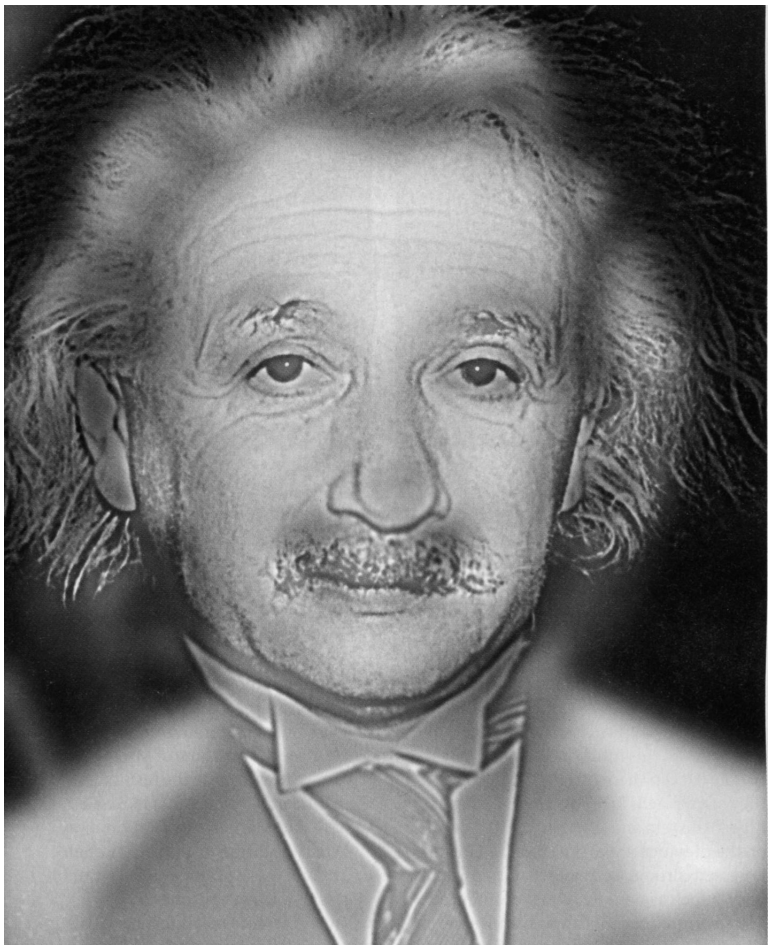
I hope this brief editorial has put a new light on the common misconception of an academic institution as a "great tank of ideas" that are to be transferred uni-directionally to the student. The reverse flow of ideas is of even more importance. The benefits of a group of students interacting strongly with each other and just lightly with the institution has been pointed out recently in the UK press. One finds that in certain years, groups of students gain more than the statistically expected admission rates to prestigious institutions, because they have benefited from each of the others work in their studies, in a way which is the complete antithesis of the common idea of competition. Allowing competing people and institutions to interact, with free flow of information, is really what universities are all about. **–30-**

Homines dum docent discunt

Appendix

There has been animated discussion on the AD list recently about the possible ways of interpreting the mathematics underlying wave propagation and antenna function. In particular, there are the people who would like a single way of looking at the problem of displacement current; i.e. does it or doesn't it give rise to radiation? And there are the dualists, who claim that there are many possible views or physical interpretations of the mathematics, the correctness of which is not much disputed.

The reader is invited therefore to look at the collection of pixels in the image below, both from a close range and then from further away (perhaps several feet, depending upon screen size and eyesight). It is clear that the pixel distribution does not change with the range of the observer. But the interpretation made by the brain certainly does change. Little teaching examples like this are suggested by the discussions on the list, and may be put to use in encouraging flexibility of thought in the reader/student.



Do you believe this "information"? Look close to, and then from afar.
Image from *New Scientist*, 31st March 2007

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TO BIOGRAPHY OF AUTHOR
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