

Participation of Distance Learning Students in Experiments

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INTRODUCTION

The main negative criticism against distance learning is that laboratory work is an essential part of all branches of technology and natural sciences. One can infer that this is so from two observations: (a) Colleges have residence requirements mainly because the faculty believes that this creates an opportunity for practical work; (b) Many scientists, like Carl Sagan and Karl Popper, think that controlled observations are important components of the learning process (Popper, 2002, p. 191). Even in human sciences, hands-on work prevents blueprints for unrealistic social engineering projects. In arts, supervised practice and rehearsal is desirable, to say the least. In Earth sciences, Astronomy, and Astrophysics the student has to examine paleobiological records, reconstruct the history of sediment records, collect samples or investigate the availability of samples from individual researchers and repositories, perform observations, and deploy data acquisition systems. Most distance learning systems ignore observations, practice, sample collecting, and laboratory work. Therefore they are vulnerable and open to criticism in regards to the experience and practical knowledge, given by those institutions that offer degrees based on distance education, and so are not recognized in many countries.

BACKGROUND

The World Wide Web was searched for accredited distance education degrees in the United States, Canada,

and Australia; if one is to believe in the completeness of sites like Guide to Online Schools (2000), most institutions limit their activities to business, law, religious studies, and social services. There are very few Engineering degrees, most of them recognized by the Commission of the Distance Education and Training Council (DETC), which the U.S. Department of Education (2007) recognizes as an accrediting agency; however, the catalogs of institutions that offer this kind of education list only Associate degree programs, which means that their alumni will work under the supervision of an Engineer, or Master in Engineering, which implies that the student already has a degree in Engineering.

From the above discussion, it seems that critics of distance learning, providers of online education, and accrediting commissions agree that engineering, natural sciences, and other subjects where laboratory work is mandatory require residence for graduation. The rationale is that distance learning cannot provide the practical expertise needed for some endeavors.

Most scientists adopt either classical empiricism or Popper critical rationalism guidelines for their work. Classical empiricism is based on experiments and observations followed by inductive reasoning. In the words of English philosopher and statesman Francis Bacon (2007, chapter CXVII), one can say that:

"...via nostra ea est; ut non opera ex operibus..., sed ex experimentis causas et axiomata, atque ex causis et axiomatibus rursus nova opera et experimenta extra-

hamus.” Trad. “...our method is the following: We do not extract theories from previous theories, but from experiments we extract causes and axioms, and from these causes and axioms we extract new theories and new experiments”.

Popper disagrees with Bacon in holding that scientific theory is hypothetical, and is generated by the creative imagination in order to solve problems; he also believes that no number of positive outcomes of experimental testing can confirm a scientific theory, but a single counterexample is decisive: it shows the theory to be false. He also takes falsifiability as the single criterion of demarcation between what is and what is not science: a theory should be considered scientific if it is falsifiable. No matter which approach one takes, laboratory work and observations can be considered the corner stone of science; Popper says: the experiment is “a rational reconstruction of the steps that have led the scientists to a discovery – to the finding of some new truth.” (2002, p. 8). From what has been said, one can conclude that laboratory work and practice in teaching of science is beyond challenge. What is challenged by the authors of this article is that distance education cannot provide the indispensable feedback that students need from Nature.

Rude (1979, 2007) list many reasons for providing laboratory experiences in a science course; here are some of these reasons:

- to demonstrate concepts and principles of science
- to teach scientific methods and attitudes
- to keep the subject grounded in reality

Another reason that Rude overlooked is discussed by Dawkins (1998) in his polemic book, and examined in detail by Matteoli (2004):

We can then write a nail-hammering manual, with all details related to fixing a nail, like depth, sound, resistance, etc. The manual... may be useful to reduce the learning cycle, but if you compare the ability of a nail hammerer who has put in 100 nails, but has not read the manual, with the ability of a nail hammerer who has only read the manual, but has never struck a nail, you will see that the one who has learned by doing is much more capable than the one who has learned by reading.

Dawkins states that to learn through practical experience creates a kind of digital knowledge, while language tends to be analogical. The experienced hammer pays attention to goals that mean all or none; for instance, one of these goals could be getting the head of the nail level with the plank. Whatever the cause is for the success of learning through practical experience is not of importance, what really matters for our purpose is that distance learning does not exclude it.

Another recurrent negative criticism to distance learning is that residence requirements put the student in contact with ancillary subjects. For instance, knowledge of Latin is not fundamental for a botanist, or a lawyer. However it is so useful that most botanists and lawyers make a point to acquire some reading knowledge of this language, if their school offers optional Latin lessons. Happily enough, all colleges and universities that are worth attending offer Latin classes, and most of them have a Classical Department. On the other hand, since people who design distance learning programs are not specially interested in the Classics, they are unlikely to add Latin lessons to the curriculum. The result is a student with a very narrow formation. Since this argument can be easily disposed of, it will be dealt with first.

ONLINE TUTORIALS

Nothing is easier than posting a tutorial on the World Wide Web. The quality of the post is not being discussed; designing a good text is always difficult. However, twenty years ago, if one wanted to offer a course on, say, Romanian Philosophy, he/she would need a place for their students to meet, print material on the subject of interest, and so on. Nowadays all that a teacher needs in order to offer a course is to know the subject. The teacher will have the whole world to look for students to fill his or her class; therefore, there is no question that she or he will work with full attendance, it does not matter how little interest the subject may draw. The result of this situation is that there are thousands of very good Latin courses; books written in Latin by people like Peano, Newton, and Spinoza are readily available, most of them with a dictionary which one can consult with a click of the mouse, grammar notes, and interlinear translation. Therefore, Latin or any other ancillary knowledge is available online even closer at hand than in a good university or college. The conclusion is that

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