Perspective

Independent Learning for the Unwilling*

Derek J. Raine

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH
e-mail: jdr@le.ac.uk

1. What is learning?

He who has no philosophy is the prisoner of a false philosophy

Of course this was written by a philosopher – a philosopher of science in fact – but even so, it might be true. It applies no less to teaching than in its original context of the interpretation of quantum theory. It also matters. If, for example, we actually believe that the role of the instructor is 'not to fill empty vessels but to light candles', then we might just pause to reflect on how many candles our mode of teaching has lit recently. Of course, it helps if we not only recognise a candle once it is lit, but know how to go about lighting them. As Leamnson says: 'To do a good job of teaching it would help to have some notion of what's actually happening when learning is taking place'.[1] But I do not agree with Leamnson in his emphasis on the neurophysiological concomitants of learning. These are important, but it is not, or not just, as Plotkin would have it, that 'When we come to know something, we have performed an act that is as biological as when we digest something'.[2] So let us begin with my philosophy, which I want to describe by an analogy that is, in essence, really only an updated take on Dewey's view that students "*learn what they do, not what we tell them*".[3]

Think about artificial intelligence. The original grand plan of AI was the 'expert system'. This computer system would be programmed with the collective knowledge of the world's experts on some topic of interest – the diseases of the lower bowel, for example – and would therefore be superior to any single human expert. However, the results were disappointing; it turns out, that wisdom and understanding cannot be reduced to a database and a search algorithm. Following on from research in artificial life, we now believe that learning is what occurs in a system when an interaction with the environment produces a feedback to modify responses in the light of experience and an appropriate set of rewards.[4, 5] Note that I am not saying that an appropriate environment and a suitable reward regime enhance learning: everyone knows that. I am saying that this *is* learning and that it is a mistake to think it takes place in any other way.

As we shall return to later, this explains a number of things. Most important of these is that students respond to the learning environment and reward system that they actually experience, which might not be the one we planned (if we did actually plan one). To take a trivial and well-known example, a reward system that focuses on the final (knowledge-based) examination encourages only shallow learning. According to a National Research Council report[6] "*appropriately designed assessments can help teachers realize the need to rethink their teaching practices. Many physics teachers have been surprised at their students' inabilities to answer seemingly obvious … questions…and this outcome has motivated them to revise their instructional practices.*"[7] Or to put it slightly more forcibly (and contentiously), there are no bad students, only bad course designs.

2. The learning environment

The first thing we deduce from this view of learning as the modification of response to environment is that teaching has to be approached collectively, because it is the combined programme that defines the student experience. This is not to denigrate the standard staff development programmes directed towards delivering a better lecture or a more relevant assessment. If we are going to drag students out of their beds for a 9.00 a.m. lecture, then we have a responsibility to be organised, audible and even, if possible, interesting. And we should not treat such an event as a mere token of our devotion to the ritual of teaching. But this individual approach to improved teaching can only go so far. The course that is entirely different from every other may occasionally be an inspiration, but is more usually a distraction and at worst an encouragement to students to treat education as a series of arbitrary hurdles. The different expectations induce what Sevin-Baden calls[8] disabling disjunctions – these are conflicts that inhibit learning rather than generating creative tensions. Let me emphasise that I am not saying I want boring sameness; what I am after is a coherent variety, and a prima-donna

* Written version of a talk prepared for the LTSN Physical Sciences workshops on Independent Learning.

approach to 'good' teaching, which ignores or even by implication diminishes the context in which it takes place, does not deliver this.

Traditionally, the design of a degree programme has meant the listing of the syllabus. It would be dangerous to dispense with this step, but it is also inadequate to end with it. Nowadays most programmes would rephrase the syllabus in terms of learning outcomes and add some transferable skills as intended (rather than accidental) learning outcomes. This is called course design. Now at this point the reader might be about to howl at my adoption of edu-speak, but I think of myself less as a course designer, more as a designer of learning environments. (Unfortunately this term is being appropriated to imply an association with the virtual learning environments of e-technology, but it should be clear that that is at most a small part of what we are talking about.)

So what is a learner environment? We can look at learning from the viewpoints of subject knowledge and skills, student prior experience and goals, the assessment regime and the community context. An overall learning environment is then is an alignment* of these knowledge-centred, learner-centred, assessment-centred and community centred foci.[6] Bransford et al. note the importance of alignment in this regard: "*Many schools have checklists of innovative practices…. Often, however, these activities are not coordinated with one another. …[P]roblem solving may be 'what we do on Fridays';…formative assessments may focus on skills that are totally disconnected from the rest of the students' curriculum. In these situations activities in the classroom are not aligned*." One might wish to extend the list beyond the classroom to apply this to University education, but the principle is the same.

3. Resource-based learning

New use for lectures

One might think naively then that the design of learning environments begins with a blank sheet of paper. Unfortunately, blank paper is often in short supply in university teaching. One has to start from where we are and what we have always done, and that is the traditional lecture course. That would seem to be the knowledge-centred environment sorted. However, here we appeal to a little test we have done in the physics department at Leicester, which was purely small-scale (a single class) and anecdotal, but which we found surprising and provoking. We took some examination questions that seem to have been answered particularly badly, in our case, as it happens, on the theory of relativity. Then we looked at the students' notes on this lecture material. In many cases we found that the poor examination answers were quite faithful reproductions of the students' notes. This may not be what we think we said or wrote, but it was what was heard and seen.

Of course, if our lectures merely repeat the material in a book then the outcome should be different: obviously we should get approximately what it says in the book – which might suggest a possible short-cut! The lecture course was invented to transmit information that was not readily available in printed form. It has survived because no-one believes that there is a book that treats their subject exactly right, because it is easier to be talked to than to read, and because it is an easy way of providing a community centred environment. The first is another example of perfection being the enemy of the good. The second is why students always prefer being taught to learning (which would be nice if it worked). And there are better ways of embodying a sense of community than simply sharing the same air supply.

We have, however, found that we can adapt the system by giving the lecture a useful role, while making print based media the main source of standard information. In effect we have introduced into our core physics courses at Leicester, mainly in years one and two, a form of resource-based learning (RBL), in which, unlike the original concept of RBL,[9] the relevant resources are rather closely defined and integrated with student activities. The course structure defines clear and varied roles for the lecture, which makes sense as the students move through each unit or topic on a fortnightly cycle. Each unit has an introductory lecture, which is intended to provide the motivation and explain the intended learning outcomes. It specifies the reading to be done by the students, which is subsequently checked by a short web-based multi-choice test. It also guides students in how to do the reading. The second lecture deals with the approach to problem solving in the topic area (or how you actually think of doing what is obvious after you've been told it). There is then a class session in which the students work in groups on set problems with the staff available for group consultation. "*Opportunities to work in groups increase the quality of the feedback available to students*."[10] It also provides a better opportunity to foster a sense of community and shared goals. This is helped by the team teaching approach in which the team of lecturers for each module share the lecturing but are all present to supervise the problems class. In the final lecture of each unit the lecturer can draw on the class experience to address the students' needs, which also, incidentally, can be used to inform the presentation of material in future years. Students then have time to complete an assignment for the unit, which they must hand in for marking and on which they receive feedback in small group sessions.

* The term 'alignment' is taken from Bransford; 'integration' might be better.

There are many technicalities of scheduling, variations in rates of progression and so on, the details of which need not detain us here. We can complete the picture simply by adding that this approach is used with a class of around 90 students for all the core teaching (i.e. the material that every student has to cover), which is almost the whole course in year one but becomes a decreasing part of the programme in each succeeding year, and disappears entirely by year four (for the M.Phys. cohort). It is replaced by specialist option courses and by a variety of project work that encourages independent learning, in order to reinforce core material and to take subjects to the research boundaries. The main question is, have we integrated the environments in a coordinated way and, if so, does it work? The answer, as one might guess, is yes and no. We have evaluated this in various ways, including peer review of various elements and focus groups of students meeting with us and with external consultants. We shall not give all the details here but summarise qualitatively some of the main points.

The learning environment

Let us start with the knowledge environment. It has to be admitted, despite what was said above, that the textbooks we use are not entirely suited to the purpose. For the first year the US compendium text is far too long (hence too heavy) not very interesting (despite the plentiful pages devoted to supposedly interesting asides) and rather too susceptible to pattern matching of formulae in place of problem solving. If the published literature is representative, then our second year students do not seem to be comparable with any anywhere else in the world. (My colleagues, and in some cases the students too, assure me that the books are either too hard, too easy, too long, too short, too boring, too mathematical, too descriptive…or, failing that, just too out of print.) This has made it difficult to dissuade some colleagues from relaxing back to the old, didactic style of lecturing. That said, the one thing this approach achieves above all else is to define the syllabus in terms of what can be reasonable absorbed in the time available, since core teams have to specify fortnightly assignments to cover the corresponding material and this, at least, is the first requirement of deep learning.

The student-centred environment is designed to lead to independent learning. Our greatest difficulty is to develop a work ethic that will enable this to take place. The idea is that we set students an example of how to work effectively by providing a lot of support in the core programme; by this means we hope to launch them on their optional courses needing much less direction. The first problem is that for many of our students their merely adequate entry grades can be put down to the fact that they were not really trying, and these students expect to get a satisfactory degree by continuing not to try very hard. In much the same group are those students whose entry grades were obtained for them by their teachers. It comes as a surprise that we are not going to get their degrees for them, especially when they compare their expected workloads with what they perceive to be required from students in other disciplines. The feeling of working hard was not what they were led to expect University life to be about, but it is in fact the most important experience we can give them. Against us it has also to be said that the transition from the highly directed core learning to the freedom of the options programme is not yet successful. The worst of it is that students have asked for further support for the option courses and that we have started to increase our provision. This seems to go against the attempt to develop independent learning. On the other hand, in our various focus groups, our final year students almost all volunteer the information that in retrospect they understand completely what we were trying to do, and for many their only regret is that we were unable to persuade them to participate more fully. In our defence it should also be said that the various independent projects in later years are often done very well.

An important feature of the student-centred environment is the inclusion of transferable skills as a natural and seamless part of the programme. For example, the first physics that students do involves working in groups, but it is not an exercise in group working. I think it also helps that they see us working as teams, which is where we probably have a natural advantage over many other disciplines. To many minds, the student-centred approach implies an entry test to determine what prior knowledge students bring. Having employed such a system, we have abandoned it in favour of variable pacing of progression through the programme. This means that students themselves determine the areas and topics to which they have to devote more time, rather than being categorized externally. I feel much more comfortable with the fact that we do not pick out students by exploring where they lack competence, but allow them to cover rapidly the areas in which they are confident; this comfort stems from the feeling that this is more in keeping with an independent learning approach.

Assessment

Perhaps the most difficult task is the design of the assessment regime. Despite the reservations about the mixing of support and evaluation that it entails, we have been driven to an environment in which everything that has to be done is (summatively) assessed. The driver here has been student attitudes: they demand that everything they do ‘counts’ and will not take seriously anything that generates purely formative feedback that does not ‘count’. Perhaps this should not be surprising, especially in view of what was said about assessment earlier, but it is. It is

surprising because many of our students will offer hours of their time to help with activities for schools and the general public, will volunteer to show prospective students round the Department in return for what, in the end, seems to be an egg sandwich and a biscuit of undistinguished provenance. They will offer to serve on student committees, organize conferences and all manner of helpful things without requiring that it 'count', but will not accept any other currency than marks as a reward for doing physics. What we do could be regarded as tests five-times a week, but by keeping the overall contribution to the degree small, students appear to see it as five-times a week distribution of the 'sweeties'. We do in fact maintain marks to the inherent accuracy of Excel spreadsheets, rounding only on the last day, so to speak, but none of these continuously assessed activities can affect any visible decimal places in the overall mark. There is clearly some strange psychology at work here, in which the mere thought of reward suppresses the students' numeracy systems.

On the other hand, we do keep a very strict record of attendance at all activities, apart from lectures (which are voluntary), and students receive a summons to come and explain any absence usually within hours of their absence being noted. I like to think this is not so much 'big-brother' as an obvious indication that someone cares. What happens is that after a couple of weeks all the students have learnt the rules and adopt a professional attitude to the eight hours a week of compulsory attendance: it becomes part of the community environment.

The community

One might think that the obvious approach to the community environment in a system that claims to produce independent learners is to 'leave students to get on with it'. However, on its own this would probably have the effect of producing what might be called a survival strategy, the symptoms of which are shallow learning and question spotting. Nor can an appropriate sense of community be generated by the occasional staff-student skittles evening or football match. Integration of the community environment means that it carries forward the student-centred approach, so that the way in which students work informally together matches the way that they have their formal classes, working either alone or in groups, in a physical space to which they belong and in which they have access to the knowledge environment – in the human version as academic staff, as well as the internet. Perhaps we are exceptionally fortunate in being able to provide this physical environment, with lecture theatres, laboratories, computer areas, workspace and communal social space and (most) staff offices all within the one building, but this good fortune did not come about by accident.

Conclusions

To conclude then, what about this unwillingness of staff and students to emerge from the comfort zone of traditional teaching methods and embrace innovation? This supposedly legendary reluctance is in fact mythical on both sides. Students are not experts on pedagogy, have very little interest in whether your teaching methods are innovative or not, and come prepared to engage in the game of getting a degree. It is our job to write the rules so that the game is worth playing. But writing the rules is also part of the game: the learning environment has two co-habitants, the staff as well as the students. And the knowledge-centred, teacher-centred, assessment-centred, community-centred environments have to be integrated for the staff also. My experience is that resistance to change occurs where it creates tension in this integration, often where innovation threatens to fracture the sense of community. Where innovation creates win-win situations, or at least offers the prospect of such, I have not experienced open antipathy to it. Of course, I am aware that the traditional mode of conduct of academic warfare is to agree to everything and do nothing, so opposition becomes covert rather than overt. But the principal weapon in politics is patience, and if your ideas are right, covert opposition can be changed without anyone having to be seen to climb down.

References

1. R. Leamnson, *Thinking about Teaching and Learning*, Trentham Books,1999.
2. H. Plotkin (1994) *Darwin Machines and the Nature of Knowledge*,Harvard University Press, 1994.
3. J. Dewey, *Experience and Education*, Collier, 1963.
4. Grand S, *Creation: Life and How to Make It*, Weidenfeld and Nicholson, 2000.
5. C. Adami, *Introduction to Artificial Life*, Springer, 1998.
6. J. D.Bransford, A.L. Brown, and R.R. Cocking, ed., *How people learn: brain, mind, experience, and school*; Committee on Developments in the Science of Learning, Commission on Behavioral and Social Sciences and Education, National Research Council, 2000.
7. E.F. Redish, *Discipline-Specific Science Education and Educational Research: The Case of Physics*. Paper prepared for the Committee on Developments in the Science of Learning for the Science of Science Learning: An interdisciplinary Discussion, 1996
8. M. Savin-Baden, *Problem-based Learning in Higher Education: Untold Stories*, SRHE and Open University Press, 2000.
9. K. Exley and G. Gibbs, ed., *Course Design for Resource Based Learning – Science*, The Oxford

Centre for Staff and Learning Development, 1994.
10. D.W. Johnson and R. Johnson, *Learning Together and Alone. Cooperation, Competition and Individualization*, Englewood Cliffs, NJ, Prentice Hall, 1975.