Transformation in e-learning

Steve Draper, University of Glasgow
David Nicol, University of Strathclyde

Preface

This short paper corresponds to a talk given at ALT-C, Sept 2006.

Original conference Abstract

This short paper explores, through both conceptual analysis and examples, the notion of transformation. Whether applying for funding, convincing staff to adopt new technology, or arguing we have enhanced learning quality, we have to argue for the impact of e-learning, and often we would like to say it has transformed learning. But is any educational technology transformative, or is transformation impossible, even though it has been confidently predicted so often by so many? Can we be transformed without noticing it (poetic justice for conservatives)? In 15 minutes, this talk will give a vivid tour of the issues, and, whatever their preferred stance, enrich the audience's ability to argue critically on this topic.

"Transformation" is a rhetorical, not an objective, term used by those wishing to draw attention to the large size and rapid pace of some change. We have examples where there seems to be vivid transformative change, but on closer inspection, not: whether a fashion change in hair colour (same old heads underneath) or a required policy of teaching with VLEs yet in fact only lectures slides are mounted in it. However similarly we have seen cases of real change (mobile phones, e-journals on the web) where the users (unlike the providers) seldom say their life has changed: they just use what is there. Transformation is a perception, and stakeholders seldom share it. In fact any simple causal event, such as a glass falling from a table and shattering on the floor, has multiple necessary "causes": a gravity field, fragile material, a hard floor covering, a clumsy gesture. Changing any one prevents the event. To understand important transformative events, we must identify enabling conditions as well as precipitating triggers. Cases and considerations such as these implicitly show the immense challenge of designing evaluations that see through the impressions of stakeholders (whether dazzled or "not bovvered") to detect change of real substance.

Introduction

Whether applying for funding, convincing staff to adopt new technology, or arguing we have enhanced learning quality, we have to argue for the impact of e-learning, and often we would like to say it has transformed learning. But is any educational technology transformative, or is transformation impossible, even though it has been confidently predicted so often by so many? Can we be transformed without noticing it (poetic justice for conservatives)?

A. What counts as transformation?

"Transformation" is a rhetorical, not an objective, term used by those wishing to draw attention to the large size and rapid pace of some change. However similarly we have seen cases of real change (mobile phones, e-journals on the web) where the users (unlike the providers) seldom say their life has changed: they just use what is there. Transformation is a perception, and stakeholders seldom share it.

We have examples where there seems to be vivid transformative change, but on closer inspection, not: whether a fashion change in hair colour (same old heads underneath) or a required policy of teaching with VLEs yet in fact only lectures slides are mounted in it. That is: many agree there's been a qualitative change, but not in real benefit, only in appearance and the means.

We can have cases of added value, which however aren't transformative: perhaps having e-journals on the web instead of paper ones in the library, supplying lecture notes in digital form, rather than on paper or not at all.

We can have cases of real benefit but no step change you could call transformation i.e. slow but cumulative improvements e.g. automobile design over the last 100 years, fall in the UK peri-natal mortality over the last 70 years.

B. What counts as valuable?

So to discuss worthwhile, as opposed to superficial, transformative change, we must articulate what we consider "worthwhile" in changes to education.

B1. Learning outcome increases

Mazur and his team tested students both at the start and end of his course; and did so both before he introduced his Peer Instruction method and for some years afterwards (Crouch & Mazur; 2001). They report a normalised gain now up to triple what it was with non-PI instruction, using the widely used standard test (the Force Concept Inventory).

Hake's (1998) remarkable paper compared two instructional methods across 62 courses with 6,542 students.

B2. Cost decreases

Discussion of costs is still relatively rare in the educational technology literature. No doubt this is due to the legacy both of research that sees educational technology as research where costs are largely irrelevant to the hoped for enormous long term benefits, and of the working context of many HE staff where teaching efficiency gains simply result in the punishment of extra work rather than in any reward, and the implicit view is of resources (costs) being fixed, and so of the question being how best to maximise learning quality.

However quite simple statements about costs can add another dimension to the argument. For example Draper & Cutts (under review) in reporting on a trial remedial programme for computing students, estimated that saving a single student from withdrawing for a single year would more than pay for the whole intervention. This emphasises both the importance of actually measuring whether any dropouts are prevented, and also that extremely modest success would justify it financially. In contrast, most polemics against large class lectures as a method fail to mention costs, yet introducing teaching in groups of 20 (say) for a class of 600 would require 30 times more contact hours. Would such authors really wish to print claims that the change in method would raise learning quality by 30 times?

B3. The questionable role of money as a driver

The paradox here is that many funders expect new methods will save money, in which case surely teachers and institutions should adopt them without any other inducement: offering them money to do so seems a contradiction. So is money useful or effective in promoting worthwhile change?

Innovations like Mazur's peer instruction show that money isn't always the driver either of innovation or of its spread: it came from developing a new teaching method based on pedagogical considerations, and not on getting big grants or introducing expensive new technology. In the PCR directed by Twigg, money was important to attracting course teams to participate in redesign at a time when there was a high perceived risk because of the lack of good evidence for substantial benefits. However Twigg is now working on demonstrating that course redesign can now be promoted based on the (now established) evidence rather than on financial inducements.

It is possible, then, that funding directed at creating convincing evidence may be most effective in the long run. This is consistent with some indications within our own project that supplying educational evaluation (as a service) to course teams is more welcome than just money. However the truth may of course be complex. For example perhaps money is best at getting teachers' attention, both privately and organisationally (what will gain departments' agreement to allow change); and this in turn then enables redesign to be considered, even if the money isn't actually essential to the implementation.

Perhaps there is simply too little understanding generally of how teaching change can be brought about, and what the different activities involved are. The PCR was essentially targeted at creating evidence, and once created this often is a powerful lever in changing others' behaviour by having changed their knowledge of what is possible and effective. Creating evidence is normally called

"research", but in HE "research" and "teaching" are by convention opposites so it can be forbidden to spend teaching money on research: it would have to be called "investing in teaching" or at least "development". But if it is called those things, then the measurable deliverables would have to be teaching outputs not knowledge. Such implicit reasoning rules out even Twigg's simple two step strategy of first creating knowledge about how to achieve transformation, and then promoting its application. On the other hand calling it "research" seems to have led to endless technological demonstrations without regard to saving money and often without regard to solving significant present learning and teaching problems; and so may be behind the continuing absence of transformation.

C. Should we go for means or ends?

In order to precipitate transformation, should we focus on means or on ends: on a magic bullet that has big effects even if we don't understand them in detail, or should we focus on precisely what we want, using any means we can to achieve the targets we set ourselves. This choice between strategies is not obvious.

Exploration is one important type of research, while careful planning is most productive when applied to repeating established effects. Furthermore, the most dramatic ("transformative") cases of ICT revolution in recent years have seemed to show the power of focussing on means: the internet and web, and texting on mobile phones are both cases of unplanned revolutions where utility was discovered after design, implementation, and deployment had all been done. (Similarly in medicine some of the most transforming discoveries have been established long before they were understood: Jenner's vaccination with cowpox, penicillin without knowing that it works by preventing crosslinking in bacterial cell walls.)

However the best examples of worthwhile transformation using ICT in education seem all to have come from focussing on ends. That is, educational benefits from redesigning courses and employing ICT are not natural or spontaneous, let alone automatic and normal.

C1. Mazur's "Peer Instruction"

Mazur's "Peer Instruction" is used here as an example of innovation driven primarily by a pedagogical idea, rather than by funding or technology, that has both achieved large improvements in learning outcomes on an independent test measure, and subsequently been adopted in numerous other institutions. Other examples might be Problem Based Learning (PBL) in medical schools, or Just in Time Teaching (JITT) for first year science classes (Novak et al., 1999). Its essential idea is to use class time for peer discussion (even in very large classes), structured by a specific recipe based around well designed "ConcepTests" designed to test understanding, and which tend to provoke different views. (See Mazur, 1997; and Nicol & Boyle, 2003 for more details.) Mazur first used it in 1991, and has since reported on 10 years of experience with it, and has shown that it leads to large learning gains compared to previous methods of teaching those classes (Crouch & Mazur, 2001).

It is a particular developed form of the method of "Interactive Engagement" which has been shown to be widely effective in this subject area of introductory physics courses (Hake, 1998); i.e. many other teachers have obtained demonstrated benefit. In current implementations this is often supported by technology in the form of Electronic Voting Systems [http://www.psy.gla.ac.uk/~steve/ilig/]. It is mainly used in physics classes, and has spread widely in that teaching community.

D. The Pew Program in Course Redesign

The PCR, conceived and directed by Carol Twigg and funded by $8.8M from the Pew charitable foundation, ran 1999-2002 and gave $6M to 30 course teams across the USA to introduce redesigned courses. They spanned many disciplines (including English, Maths, Chemistry, Psychology), and institutions of many kinds from community colleges to private 4-year universities. All 30 showed significant cost reductions, and 25 showed significant measured improvements in the learning outcomes. The funding process was both highly selective, and highly interactive and supportive, so that successful applicants had by the time of the final award a detailed implementation plan ready to go that satisfied both their own aims and those of the funders. (http://www.thencat.org Twigg, 2003)

E. Lessons from the PCR

E1. You can achieve measurable, comparative benefits

The great majority of ICT applications to education ("e-learning", etc.) have declared success because the technology mostly worked, learners quite liked it, and some learning occurred. They have not been able to show learning improved compared to non-ICT approaches, and they never saved money. But in fact success is possible.

E2. You can have it both ways

The PCR showed you can both decrease costs and increase measured learning outcomes. This fundamentally breaks the assumption of a zero-sum triangle of cost-quality-time: that to improve one or two of these measures requires accepting losses on the other one or two: in particular, that raising quality requires increasing costs. The PCR implies that this dictum can be broken, that new methods (supported by new technology) offer a fundamental improvement in what is possible in optimising these constraints. That is, it implies that the use of ICT actually can change the playing field i.e. transform the learning design space.

E3. You get only what you aim for

The PCR also shows that you only get such benefits if the redesign is carried through with the desired benefits clearly in mind, and consistently moved towards. In the PCR, the redesigns were iteratively developed with a requirement for cost reduction, and a requirement for some particular kind of learning improvement. In the past, redesigns have almost always been carried out with no particular requirement for cost savings, and usually with no focussed requirement for learning improvements: instead many projects have been essentially exploratory: trying out some new method or equipment, but without a strong and specific goal of the effects desired.

F. Supporting conditions for beneficial redesigns

Given that it is now a clear possibility, even if the conditions for it are not yet well understood, what might it take to promote beneficial redesign of courses? We briefly discuss six possible enabling causes, that could require special action to make beneficial redesigns actually happen.

1. **Motivation** to undertake significant changes and redesign.

The PCR paid $200,000 per course team. This was probably an essential factor at the time. Now the existence proof of attainable benefits is there, it may no longer be necessary: course teams can rationally hope for benefits independently of outside inducements. Either the hope of saving money which they can retain, or of achieving their own educational benefits e.g. an improvement in student retention, and raising of learning standards, may now be sufficient to motivate a redesign and the substantial effort and risk it entails. It is likely that an important factor here will be how the organisation exerts indirect but essential influence on motivations for course redesigns.

2. **Pedagogical ideas** about what kinds of change can be powerful, and for what effects are important. Perhaps even more important is the capacity to translate abstract educational ideas into the specific discipline and course context of the redesign. There are mixed indications here, but satisfying this condition in one way or another is likely to be an essential factor. It is the redesign of the teaching and learning approach, not the mere presence of technology, that determines learning outcomes, as technosceptics have always argued (Clark 1983), and as was assumed and acted upon in the PCR.

3. **Staff development** (rather than money or equipment) could prove to be a strategic factor here. While in very general terms this could be seen as an aspect of [2], the distinction is that [2] is about thinking up ideas to put in a course design, while [3] is normally about whether an academic has had personal experience of using specific delivery methods that may be required in redesigns e.g. running a course in which there are no lectures, supplying on-demand interaction over email without being swamped,

4. Moving to a **culture of evidence-based teaching**. Our experience is that many teachers are interested in and responsive to reported evidence that is relevant to course design decisions, but do not generate any themselves. This means that their post hoc judgement of their own decisions often rests only on their perceptions of whether the volume of student complaints goes up or down, and whether the perceived quality of exam performances improves or worsens. To move away from staying with habit ("standard practice"), to be comfortable in maintaining and embedding new course designs etc.

probably requires systematic defining of what would count as good evidence for and against the success of each given redesign, and embedding its collection into course designs. This in turn will progressively encourage further course redesigns because many more cases will come into existence with a clear evidential message.

5. **Personal dissemination.**

In considering adopting some new method, one of the things a potential adopter most values if they can get it, is a direct talk with a person who has done it successfully. But why should such people give such talks? There are no careers in "course redesign" (though there are careers in educational technology: for people who usually do not teach, much less design, courses). The drivers of both supply and demand for research papers are absent for dissemination about teaching. Those who design courses are not required to cite the literature on course redesign to get a course approved (demand creation), nor are they required to write papers about it (supply creation).

6. **User centered services**

The more effort is removed from the course team and something provided as an effortless service from their point of view, the more likely it is for it to be adopted. An example from a few years ago at one of our universities, was the provision of basic IT training for undergraduates by a central unit. This meant that departments did not have to do this from their own resources, did not have to timetable it at the expense of something else, and did not have to agree among themselves even whether it was of any value. This put individual teachers and course teams in the position of being able, if and when they wished, to take it for granted and just require their students to submit word processed work, or perform spreadsheet calculations. Naturally, this led to relatively rapid adoption, as soon as uses for relying on the training came up.

One level down in scale, one of the most neglected aspects of support for beneficial redesigns is auditing all educational technology for the costs, usually learning costs, it imposes on its users. For example, currently VLEs force students and staff to use the email system built into the VLE instead of the one they are already required to use elsewhere: doubling their learning burden and fragmenting their records. All this bad software design increases the costs to users, and slows uptake, and it tends to do so in two ways. First is the intrinsic cost of wasted time. Secondly, though, typically running a course is a complex and consumes both time and possibly more importantly, attention. Making things simpler from the viewpoint of staff and students can often address the bottleneck slowing change.

G. A last word

We've argued that, contrary to intuition and experience in some other areas, transformation of HE by ICT has not been achieved by focussing on means, but by focussing on ends: on what exactly we want to achieve. The substantial examples of larege, measuralbe benefits have occurred only when this was done.

This is even more necessary, of course, for non-transformational improvements i.e. gradual cumulative change: only got by steady focus on (measurable) goal outcomes.