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**Overview document to accompany the papers presented by Andre Clark in
submission for a PhD by publication.**

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Title:

Developing an Economic pedagogy for an enacted environment in which cognitive differences matter.

Acknowledgements

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Abstract

The aim of the research presented here is to increase the utility of introductory Economics (particularly Microeconomics), to Business undergraduates. The motivation for this was my desire to improve on the poor outcomes previously recorded for students at the University of Glamorgan (and elsewhere), and avoid the effective loss to them of the many important discoveries made in this field. Doing this required an investigation into the nature of the problem and a solution, both of which are encompassed in the seven papers herein presented and discussed in this overview.

Chronological list of papers.

Please note: Journal rankings using the ARC-ERA 2010 international list and the ABS Business journal list are shown in brackets as a letter and a number respectively. Details of the interpretation of these scores is included in appendix 1.

1. Brooksbank, D. J., Clark, A., Hamilton, R., & Pickernell, D. G. (1998a) "A critical appraisal of WinEcon and its use in a first-year undergraduate Economics programme". ALT-J Research in Learning Technology, 6 (3): 47-53 (A) (2)
2. Brooksbank, D. J., Clark, A., Hamilton, R., & Pickernell, D. G. (1998b) "Views from the Trenches; Lessons from the Introduction of WinEcon into a First Year Undergraduate Programme". Computers in Higher Education Economics Review, 12 (1): 13-19 (C) (1)
3. Clark, A. (2001) "What can we learn about computer-based learning from the Teaching and Learning Technology Programme's flagship product?" Innovative Approaches to Learning & Teaching in Economics and Business Education. Ed: Peter Davies, SUP. ISBN 1 897898 82 7.
4. Clark, A. (2003) "Methodological individualism, cognitive homogeneity and environmental determinism". Journal of Economic Methodology, 10(1): 79-85. (B) (2)
5. Clark, A (2009) "An experiment in teaching invention". Education and Training. 57(7): 516-525. (A*) (1)

6. Clark, A. (2010) "Educators vs. Entrepreneurs: Traits and bias in the teaching of SWOT". *Journal of Further and Higher Education*. 35(2): 1-14. (B) (1)
7. Clark, A. (2013) "De-mystifying inventive thinking. A survey with pedagogic implications" *Journal of College Teaching & Learning*. 10(1): 13-22. (C). (Available online Winter 2012, in paper form from January 2013)

Introduction.

In an attempt to identify the nature of the problem the first three papers (Brooksbank *et al.*, 1998a, Brooksbank *et al.*, 1998b, and Clark, 2001) evaluate the pedagogy of modern economics, primarily as revealed by the Computer Assisted Learning (CAL) package; WinEcon. This was found to be flawed in respects that are particularly significant for Business (and Enterprise) students. These flaws are born out in the degree to which the transmission approach to pedagogy is employed in WinEcon and the extent to which environmental contingency is implied to dominate over the choices made by firms. The result is an approach which combines an unempowering view of Business with an uninspiring approach to the teaching of it.

In the fourth paper (Clark, 2003), I argue that these flaws stem from the methodological assumptions of mainstream Economics regarding the homogeneity of peoples' cognitive processes. This leads to a circumscribed view of the scope people have to interpret things differently and act in different ways, which in turn implies a level of powerlessness to affect the economic environment that is unwarranted by the psychological evidence for such homogeneity. Although I coin the term 'cognitive homogeneity' in paper four to describe this (Clark, 2003), the emphasis in this paper is on what it does rather than what it is, since the term itself merely describes the degree of uniformity in cognitive processes implied in the methodology of Economics. Its consequences get rather more attention in this paper since in terms of pedagogy these are profound. In particular, the survey work reported in this paper suggests it imposes limitations on students' entrepreneurial and strategic outlook and motivations. This issue is also further explored in paper six (Clark, 2010) and cross-referenced to debates in the Psychology literature in paper seven (Clark, 2013).

This critiquing is an academically valid exercise in its own right. However, since the primary concern I had in undertaking this research is pedagogy, the question of what to do about it is discussed both in the papers already referred to and in paper five (Clark, 2009). In this paper I show what can be done in the classroom to remedy both the erroneous impression the assumption of cognitive homogeneity creates and its de-motivating effects. Although this is also a feature of the previous papers, in paper five (Clark, 2009), this was extended to encompass a consideration of the effect of actions that impact on the environment, particularly novel ones, such as inventing. In all the papers the conclusions and recommendations reflect changes in my own teaching practice that resulted in outcomes that were more consistent with the stated aims of Business Studies and Enterprise courses as measured by motivations and intentions. In the last paper, paper seven (Clark, 2013), I further extend the critique and bolster the pedagogic recommendations by dealing with a potential flaw in my solution.

The following schematic shows the relationships between the issues, papers and conclusions.

AIM: In light of poor outcomes in educating business students in (micro) Economics to build a better bridge of understanding between the issues (below left) and pedagogy (right). This necessitated an investigation of the cognitive assumptions used to enact this conception, and if necessary reject them.

(note: the letters below each paper indicate what kind of research technique was employed, E=experiment, R=regression, Q=qualitative, A=action research, C=content analysis).

ISSUE

Economics, seen as the study of choice in context, was observed (in classroom observations) to promote the primacy of context over the kind of choices that make a difference to that context (see p.5). This contrasts with the management literature o.: strategic choice (see p.26), perceptions (see p.15), and enactment (see p.24). But Why?

But Why?

Habit? OR is it intrinsic to the method?

Can we test the resilience of this determinism by looking at the tools that encapsulate an element of both approaches that Economists nonetheless teach, such as SWOT, which was born from this debate.

Looking at 'O' allows a fine distinction to be made between context and choice, since we can see opportunities as either environmental gaps or cognition dependant and enacted. With genuine choice (Loasby, 1976) 'O' can include genuine novelty, such as invention as well as enterprise more generally. This can be tested by looking at how (and why) this can be taught.

But the cognitive process here could be unique given the nature of invention and could therefore fall outside the scope of a science of generally rational behaviour (Economics). This would make this a rather weak test of the thesis and suggests that the thesis applies only to a few pedagogic gaps rather than all of it.

FINDINGS ON TOOLS

WinEcon summarises / encapsulated the standard (micro, neoclassical) Economics approach, see Papers 1,2,3 (S, Q, R, A, E, C).

Paper 4. (S, Q, A, E).

Variety in perception (and the cognition that gives rise to them) are ruled out (cognitive homogeneity assumed, see p.5) by Methodological Individualism, as this reifies / exogenises context, by dividing the context from the conscience

Paper 6. (R, Q, A, S).

Cognitive differences of entrepreneurs shown to be valid, which suggests that different perspectives need to be evaluated properly rather than assumed away

Cognitive homogeneity imposed by lecturers, ruling out genuine choice again.

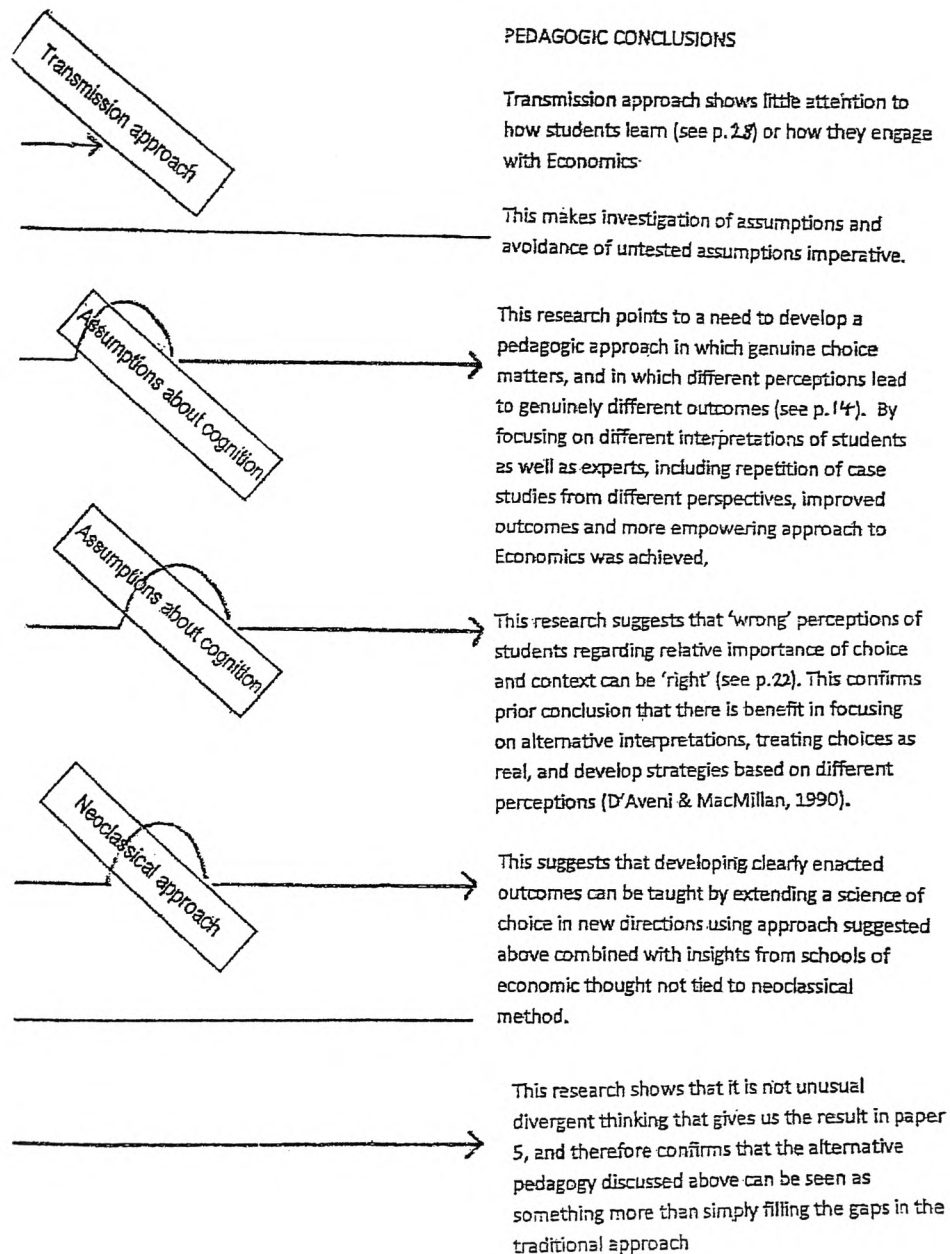
Paper 5. (E, A).

Hétérodox (Austrian Post Keynesian, Institutional) approaches not hampered in same way by methodological assumptions

Paper 7. (E, S, Q).

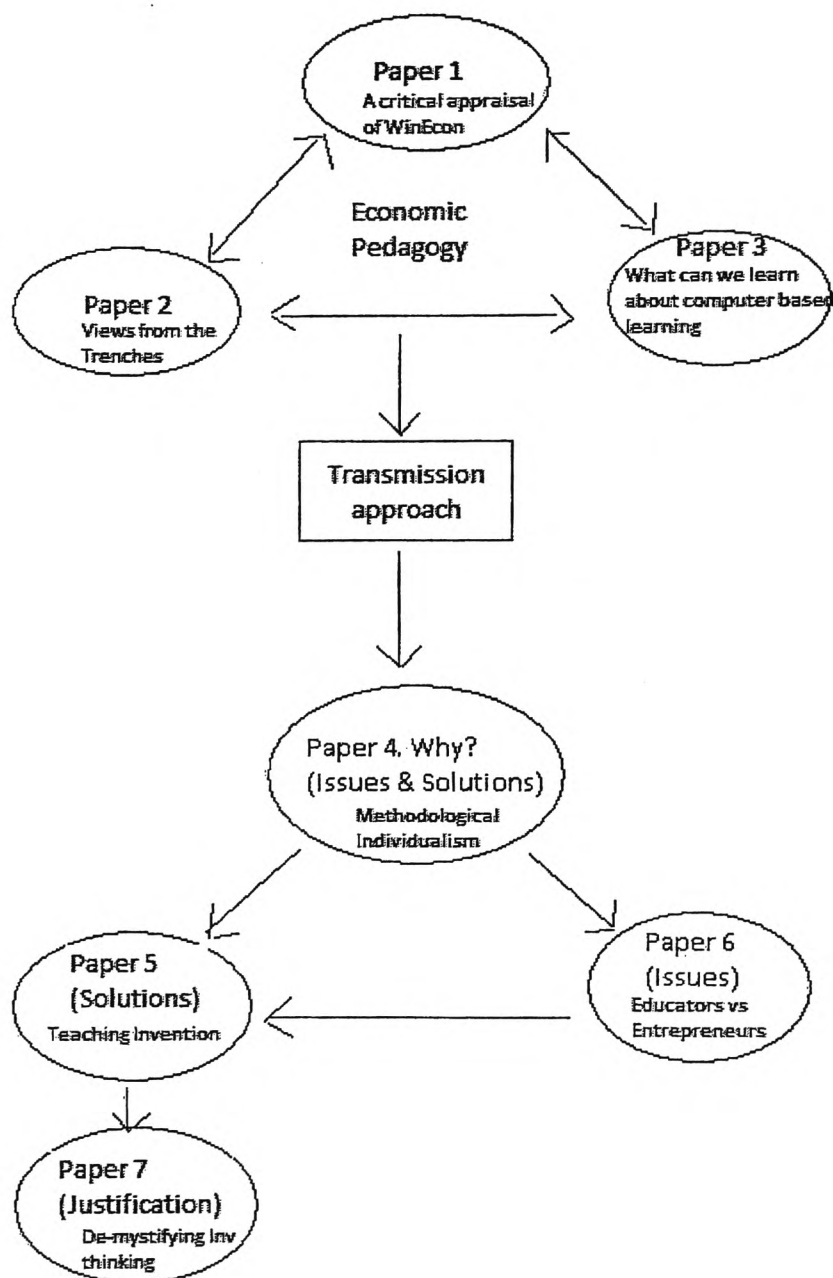
Cognitive process in invention seems to reflect everyday types of thinking, rather than any exceptional modes of thought.

Figure 1.



Further clarification on the relationship between the papers is shown in Figure 2, below.

Figure 2



The initial teaching observations that inspired the research in the first three papers (in the top triangle in Figure 2), encompassed seven UK Universities and began in the early 1990's. Subsequent research included a number of other colleges and some lectures given by Economists working for the Chartered Institute of Purchasing and Supply. Undertaking these observations had initially been motivated both by my desire to become a good lecturer (on entering the profession from industry), and by the concerns expressed by Business students about the relevance of what they were being taught. I had assumed that since all my new colleagues shared my concerns this would be mirrored in a large and growing literature on this topic, when in fact there was something of a dearth and a concomitant lack of innovation in teaching methods (Becker & Watts, 2001).

By the turn of the decade students' negative perceptions of Economists' teaching was being more widely reflected in the literature (Allgood et al., 2004), but there was still relatively little on the specific issues facing Business students. At Glamorgan we were lucky in having Phil Race, a leading thinker on pedagogy, as professor of Education since he took it as part of his duties to encourage all members of staff to reflect on their own teaching practices and assumptions. Phil took a particular interest in the research I was doing, ostensibly because of the need to address the practical issues and improve outcomes at Glamorgan, but also in part - I suspect- because of the novelty of having an Economist take an interest in such research.

With hindsight it seems rather obvious that an Economist should look at assumptions, since any introduction to Economics begins with the edict to question assumptions. However, it was the methodological nature of the assumptions that I identified in paper four (Clark, 2003)

that made them difficult to trace because methodological assumptions are rarely discussed outside of a methodology class (Hargreaves Heap, 2000) and are seldom linked to discussions of Economic pedagogy (Hoover, 1995). This finding was particularly significant for the direction of this research, as can be seen in Figure 2 where all the remaining papers are depicted as deriving from paper four. One of the difficulties in developing this paper was the aforementioned lack of preceding literature on which to build. However, this investigation was also hampered by the fact that methodological discussions in Economics are dominated by mainstream neoclassical positivism to such a degree that 'for or against' debates tend to crowd out issues of heterogeneity (Sen, 1989), such as those that I eventually identified as the crux of the problem (Clark, 2003). The net result was that while looking at WinEcon was fruitful insofar as it summarised the current practice that I had witnessed -and thus the nature of the problem in pedagogic practice- it was of little use in identifying the actual source of the problem. Consequently, I determined that if I was to identify which assumptions in particular were causing the problem more research was required, and of a different sort as reflected in papers four (Clark, 2003) and six (Clark, 2010), in particular.

The fact that I concluded in these papers that the answer is to be found in heterogeneity is no accident, because -as I explain in the next section- I had been considering this issue for some time, in one way or another. Nonetheless, it was fortuitous that Gary Packham and others in positions of responsibility at Glamorgan Business School were pushing Economics staff into teaching more Enterprise related topics as part of a general response to the need to develop more enterprising students, (as discussed more fully in the Research Framework section). The immediate implication of this development was that it gave me the opportunity to look at how one might teach concrete and measurable outcomes that could in some way be related to the issue of cognitive heterogeneity. Invention immediately sprung to mind, since almost by

definition it relies on heterogeneity in thinking to generate ideas that no one else has had. Consequently, in the remaining post-WinEcon papers there is both a description of an attempt to take the conclusion of paper four (Clark, 2003) and exemplify it with an outcome based on heterogeneity in paper six (Clark 2009) and in the final paper (Clark, 2013) to justify those developments and ultimately, therefore, lend support to those previous conclusions.

Research Framework: Underlying theoretical, and institutional, contexts.

The following discussion takes a general-to-specific approach to the theoretical contextualisation of my thesis, and also includes some comments on the institutional context of the work. At a very general level the whole of Western philosophy can be seen as following two distinct paths with rather different conclusions for the nature of social science. On the one hand an ‘analytical’ tradition that is “the root of traditional economics,” and on the other a ‘continental’ tradition “out of which Postmodernism has developed” (Tweeten & Zuluaf, 1999, p. 1166).

Since I am inclined much more to the latter than most Economists, some explanation of Postmodernism might be helpful in explaining my approach and in doing this it is probably simplest to look at the work of particular philosophers. The first is Friedrich Nietzsche (1901), who is particularly associated with perspectivism, which is “the view that facts cannot be separated from interpretations”, which is a recurrent theme in my thesis as is his conclusion from this that “making sense of science requires a careful look at presuppositions-the priors analysts bring to their work.” (Tweeten & Zuluaf, 1999, p. 1167).

Investigating what Economists have assumed, first about the nature of teaching as reflected in WinEcon, secondly about economic determinism, and thirdly about the nature of creativity and the psyche are all key themes in my work that can be located within this type of enquiry. Indeed, my classes might be described as a form of perspectivism in practice. Part of this approach is the critical examination of interpretations, following in part the work of the philosopher Jacques Derrida (1976) and his emphasis -in applying Nietzsche’s ideas- on the

importance of understanding the frontier between the truth of things and the ‘text’ applied to it, (the representations of that truth).

Indeed, in Tweeten and Zuluaf’s words “For Derrida, everything is text ...(which)... exist in a subjective context that favors one ‘truth’ over another.... (which)... must be interpreted in context and read in various dimensions to reveal their meaning” (*Op. Cit.* p. 1167). This kind of thinking and its emphasis on the difficulty of knowing and the role of ‘subjective’ projection is complementary to distinct contributions made by economists such as Frank Knight (1921), who recognised that perceptions are often based on incalculable uncertainties, and the view expressed by Shackle (1970) that this creates the space in which entrepreneurial creativity arises. Even Keynes’s notions of ‘animal spirits’ can be seen as a postmodern moment in which perceptions triumph (Amariglio & Ruccio 2003).

All of these influences contributed to the feeling that I had that perceptions and cognitive processes in general matter in a way that current pedagogic practices do not reflect, and since “it is incumbent upon critics of orthodoxy to advance alternative ways of making progress”, (Ormerod, 2007, p.1), I felt it was incumbent upon myself to develop a pedagogic approach that pays more attention to them.

In my approach perceptions are seen both as the driver of action and as the process through which interpretations of texts -case studies- can be made, in a move “from the positivistic identification of the world with our *knowledge of it*, to the post-modernist identification of the world with our *language about it*” (Sofianou, 1995, p. 380). In other words, with reflections on contextualising interpretations rather than ‘structure’, and the role of perceptions, actions, and creativity that this gives rise to.

Such an approach also raises the issue of whose language dominates and this entails consideration of all manner of power dimensions above and beyond 'market power'. This explains the emphasis on both cognition and power in the papers and why thoughts about such things lead to papers on pedagogy wherein our understanding of such things gets transmitted to the next generation.

To my mind the links are obvious, but this is to underestimate the extent to which these are overlooked in contemporary Economics, which is why this work makes an original contribution to knowledge. The extent of this disregard can be gauged by the fact that the man who has done most in recent decades to enhance our understanding of power and how we think about it and the links to language; Michel Foucault, can be simultaneously the most cited social scientist in the World (2007 ISI Web of Science) and almost completely ignored by Economists. Indeed, happily so for some:

“Although (we) sometimes lament the monolithic nature of contemporary economics, one benefit of this uniformity is that Foucaultian doctrines can only thrive in the underworld of economics” (Foss, 2006, p.2).

A benefit, unless -I would argue- you think Economics, particularly in the Business Studies context, should take seriously anyone who makes links between power and cognition. Or you are a Business Studies student tasked with converting economic jargon into practical strategies, when even those favouring the orthodox approach admit that: “Economists will become marginalized if we are unable to communicate except in the technical jargon of analytical philosophy” (Tweeten & Zuluaf, 1999, p.1171). This is why I am happy to cite

Foucault as the final philosopher in this list of authors writing in the Continental tradition as an influence on this thesis.

These influences are borne out in this thesis, both in my thinking, and in the methods I employ, which reflect the epistemological pluralism of Postmodernism, with a combination of participant observation, content analysis, unstructured interview, Likert questionnaires, and regression analysis. This is often described in terms of some form of ‘triangulation’ (Denzin, 1970), although I personally prefer Richardson’s (2000), term ‘crystallization’, as it suggests both a multitude of angles and hints at the possibility of multiple refractions. The design of the work also follows the general approach of action research, involving a cycle of questioning, data gathering, reflection and action, which should at least comfort those who see a nihilistic tendency within Postmodernism.

The work also reflects my desire to respond to another potential criticism, but this time one that is levelled at research in Enterprise education in general, in terms of deficiencies in the use of control groups and longitudinal designs. (Gorman, Hanlon & King, 1997; Matlay, 2008). Indeed, one of the main reasons for the length of time between the start and the finish of the papers presented here was my desire to make longitudinal comparisons and to test the effect of changes made in response to issues addressed in one cohort on the experience of subsequent cohorts.

My interest in the teaching of Economics, particularly as it relates to students of Business and Enterprise began with my own involvement in such matters, initially at the London Business School and then at the University of Westminster. In particular it was apparent to me at an early stage that there was a certain mismatch between what teachers and students thought was

being taught. This was despite the fact that the two Universities in question had rather different types of students; the former being almost entirely post-graduate, experienced managers, in contrast to the mainly undergraduate and inexperienced students of the latter. This led me to think that there was at least a possibility that there were legitimate concerns regarding what and how Economics is taught, despite the fact that such concerns did not seem to feature much in the literature.

In order to generate more evidence on this I began observing the teaching of other Economists across a range of institutions. From this I concluded that there was something systemic and possibly even fundamentally different between how Economists and others perceive the world, and in particular the scope for purposeful action within it. Addressing this issue was subsequently greatly helped by the advent of WinEcon, in which so much Economic teaching was enshrined and because at my next place of employment; the University of Glamorgan, Phil Race was actively encouraging new staff to reflect on their teaching. He was particularly interested in my desire to explore the pedagogy of Economics as the tendency of others he had tried to engage with on this had been to ascribe poor results, attendance, and a lack of engagement with Economics, to the intrinsic nature of modern students.

Another contextualising factor for this thesis is the change in the role of Economics within higher education in the UK in recent decades. The sustained rise in both the number of students and the number of institutions offering Business education (Goodrick, 2002), means that although questions have been raised about the quality and purpose of it since Victorian times, there has been a marked increase in interest in such investigations since then (Cheit, 1975).

This growth is something of a worldwide phenomenon, but of particular importance in this case is the situation in Wales as this is where I went after leaving London and is therefore the context to which the bulk of the research reported herein relates. As well as sharing in the growth in the importance of Economics as an input to Business studies, in Wales we have also experienced something of a shift in emphasis away from measures to encourage foreign direct investment led growth, towards measures aimed at encouraging something more indigenous. This is reflected in the development of an Enterprise award by the University of Glamorgan's Business School as well as a host of initiatives, such as 'make an impact week', that seek to encourage enterprise amongst our Business students. More parochially, my own efforts were supported by this change in emphasis, since it underlined the importance to me of pressing ahead with the pedagogic changes that I felt were necessary to deal with my nascent concern that Economics was failing to fulfil its potential in serving the needs of Business students. This view was underlined through some of the personal associations that I made over this period with other academics at Glamorgan, especially -without wishing to sound too parochial- with the people that I shared a room with. In particular Will Williams, who felt strongly that Economics was failing to provide the foundation that we might expect it to make to his subject; Strategy, and -more recently- Paul Peachey who, in many helpful and constructive ways, has questioned what Economics can contribute to the understanding of his subject; Enterprise.

The increased emphasis on Business and Enterprise is also tied up with macroeconomic developments, with the relatively poor performance of the UK since the 1970's serving to generate a number of government investigations and reports in the late 1970s and 1980s that tended to express, in one way or another, concerns about both standards of management and

management education (Constable & McCormick, 1987; Handy, 1987). One response involved various reforms to Higher Education in an attempt to ensure that Universities and Colleges were developing in students the skills that industry required, (Holloway *et al.*, 1999), with the Quality Assurance Agency (QAA) being established to conduct regular inspections and foster an emphasis in Higher Education on both standards and employability.

Similar concerns in the USA led the American Management Association to commission McBer Associates to identify the attributes and features of successful managers (Boyatzis, 1982). At the same time others within some of the top US Business Schools, such as Harvard and Princeton, turned their attention to strategic management as a subject through which bridges between the academic study of Business and good Business practice could be built (Rumelt, 1974).

Those with an Economics background played a major part in the developments of this, with authors such as Michael Porter (1980; 1985) building on the structure-conduct-performance (Industrial Organisation) approach within Economics, wherein one major aspect of the environment -the degree of concentration in an industry- is taken as determining identifiably optimal paths for firms in terms of recognisable strategic levers, such as diversification, decentralisation, integration, and so on.

At the time the bulk of research, as summarised by Weiss (1974), suggested that there was some validity in this approach. However, doubts were cast on this subsequently by authors such as Rumelt (1984, 1991) writing from a general Business perspective, and -perhaps more tellingly- by Economists too (Schmalensee, 1989). With authors such as Kwoka and Ravenscraft (1986), and Domowitz, *et al.* (1986), describing the link between structure and

performance as ambiguous at best, the implications for finding optimal strategic paths seemed to recede rather than get closer as the number of Business Studies students, in need of such weapons in their armoury, grew.

To satisfy this market the two themes of environment and competence were shoe-horned together in devices such as SWOT analysis (Andrews, 1980), and there was something of a rebound in what we now term the 'resource' and 'competency' based approaches, as authors such as Hayes (1985) began to question whether focusing on ends before considering means was wise. Concomitant with this was a rising tide of research pointing to the need to identify and mobile assets (Itami & Roell, 1987, and Peters, 1987), that are often intangible (Barney, 1991). Two authors in particular, Hamel & Prahalad (1990; 1993; 1995) were very successful in persuading both academics and Business people of the value of shifting to a more inside to outside approach than Economics could provide and this coincided with growing evidence that a firm's ability to learn and acquire new competencies may be a more important determinant of success than industry structure per se (Sanchez & Heene, 1996a; 1996b).

This all tended to support the view in the official reports that the emphasis should be on what competencies students were acquiring in Business Schools and -to my mind- by extension, what kind of Economics we were teaching our Business and Enterprise students at Glamorgan Business School when the cornerstone of the orthodox approach was being undermined by the evidence.

The view that the traditional management education curriculum may not be adequately preparing individuals for the challenges they experience as professional managers has been a concern for some time (Pfeffer, 1977). However, these concerns have intensified in recent

years as the landscapes our students work in are characterised by increasing levels of uncertainty and ambiguity, to such a degree that many authors began to talk of hyper-competition (Bettis & Hitt, 1995; D'Aveni, 1994), and we are faced with a growing need to equip students to deal with ever greater levels of uncertainty (Gibb, 2007). Such concerns are also finding their way into policy guidance on the teaching of enterprise related topics, for example the UK's QAA now refer to the "need for flexibility and adaptability, (as) the labour market requires graduates with enhanced skills who can think on their feet and be innovative in a global economic environment" (QAA, 2012, p. 4).

With managers and entrepreneurs having to shape organizations to respond to complex challenges it follows that students looking to these careers in particular should be exposed to complexity, complication, and uncertainty if they are to be adequately prepared (Cunha et. al. 2004). This might seem rather daunting and nihilistic until we remember that we should also be encouraging them to see "their world as an opportunity-rich environment, in which they face the constant challenge of investigating, making sense of, selecting and acting on opportunities". (Rae, 2003, p. 542). To my mind all of this is born out in the need to engage with the issues of perception, interpretation and cognition in the processes of making sense of an increasingly complex world and in equipping students to recognise how creative capacities for innovation and change that distinguish organizations that succeed in dynamic contexts (Rohwer 1996) can be developed. That this may mean encouraging students to embrace ambiguity is problematic as this is something that traditionally we have tried to remove from the curriculum, (Bickford & Van Vleck, 1997). Nonetheless, I believe this is essential if we are to provide our students with a more holistic understanding of the environment than Business Schools currently provide (Hamilton *et. al.*, 2000), and if we are to overcome the

silo mentality that often leads to such boundary-spanning issues being overlooked (McCuddy & Pirie, 1998).

By addressing these issues in my classes I had hoped, therefore, that I would be making a positive contribution that would simultaneously tackle two criticisms that are levelled at Business Studies students in general: Firstly, that the fact that evidence is interpreted and acted on by people in different way often escapes them (Bok, 2006), and secondly that they are linear thinkers who lack flexibility (Bickerstaffe, 2003). Concerns that are reflected in the sixth recommendation of the recent Wilson (2012) review, that “Universities should reflect on the strategies they use to ensure that students have the opportunity to develop enterprise skills” (p.17), which I think summarises what I have done within the subject area of Economics.

Contribution to Knowledge; antecedents and reflections.

My interest in this area goes back to my undergraduate dissertation (Clark, 1985), in which I outlined my view that the increasingly popular ‘model-consistent rational expectations’ approach to dealing with the critique of traditional Macroeconomic modelling made by Robert Lucas Jnr. (1976), was misleading.

Lucas argued that the strategic advice that governments get from Macroeconomic models is unreliable when researchers fail to realise that the success of the advice they offer is contingent on peoples’ responses to it. I would argue that this is also true of the strategic advice that businesses get from Microeconomic models, although at the time the issue was largely confined to Macroeconomic concerns (Begg, 1982). There are a number of solutions to this problem, but it was the ‘rational expectations’ one that sparked the greatest interest at the time and became part of a new approach to government policy formulation (Minford, 1987), that I personally witnessed as a member of the Government Economic Service. Initially, the approach was simply to assume that the model in question is correct and that the expectations of rational individuals will converge on it (Peston, 1983). Today, we might refer to this as the ‘model-consistent’ variant of the rational expectations approach, or the ‘Muth-rational’ approach (Muth, 1961).

In hindsight, I perceive this approach to rely just as strongly as its predecessors on the cognitive homogeneity assumption that I have since identified as a major barrier to building a coherent bridge between Economics and Strategy, since expectations that do not reflect the truth of the rational expectations models are assumed not to affect their long-run properties.

Rejecting the assumption of cognitive homogeneity, therefore poses as many questions for rational expectations models as it does for more traditional ones. Two questions in particular merit further examination:

The first concerns what happens in the run-up to the point at which the truth is discovered. That there is such a run-up is not a controversial point per se, as most models combine a long-run stable point of closure with short-run dynamic adjustments to it (Bodkin *et al.*, 1991). However, phrasing it in terms of cognitive homogeneity is rather more controversial since if differences in perception matter then we have two problems that may undermine such convergence. First, we may have a path-dependency problem (David, 1985), with how things evolve giving rise to differences in what evolves, since if people see things differently what they consequently do becomes important even if in some objective sense it is wrong. Secondly, we may have an indeterminacy problem since even if people are forming rational expectations in the sense of using all available information optimally, during convergence their cognition must be partly exogenously formed relative to the model and unpredictable, therefore, both in its formation and in its consequences (Orphanides & Williams, 2002).

The second concerns what happens if there is no truth. This is a concept that gets to the heart of my thesis, since my view on this is in stark contrast with the orthodox approach. I hold that cognitive homogeneity is an assumption that is untenable because there is no truth independent of our perception of it (Clark, 2003). Consequently, reciprocity exists between perceptions and reality in which many truths may unfold depending on what we choose to believe.

In order to understand the significance of this, certain distinctions between the various terms used to depict how people use information is required: Perception, thinking and cognition are often treated as synonymous, but 'perception' is often used to connote an awareness of information received, and 'cognition' the processing of it and the action state it engenders, while 'thinking' is generally now regarded as referring primarily to inner states (Devitt & Sterelny, 1987). In traditional formal economic modelling the closest we get to any of this is usually an 'expectations' term that denotes the numerical values (for numerical modelling purposes), that people are assumed to base their future behaviour on, such as an expectation of inflation in a wage bargaining model. This means that the modelling approach can avoid the need to explicitly consider cognition, since the truth of the model is independent of the process by which the numerical values are acquired.

The 'rational expectations revolution' as Begg, (1982) called it, was widely welcomed since the point that people may get to know the truth was well worth making in an era dominated by Keynesian models in which they were assumed not to. However, the promise that it seemed to hold of opening the door to considerations of cognition and learning, since if nothing else it allows people to be active information gatherers, has been unfulfilled since the emphasis remained on solving the models and single solutions imply single truths. With one truth, and thus one path for the evolution of economic variables cognition is overlooked as the truth of the model remains independent of the process by which the numerical values are acquired. So, although the rational expectations revolution has undoubtedly brought the numerical expectations into greater consistency with the model and thereby allow for the fact that people learn, the issue of why and how remains largely unexplored. Partly this is because of the practical difficulties that allowing for variations in this entails, and partly because most

Economists do not have a problem with this assumption, (although I would like to think that some more might after reading this thesis).

My own view is that people are not rational in this sense and there is no single truth, so that even if they were their efforts would be thwarted. This is not to dismiss lightly this whole field of research, as work in this area that include the possibility of a contingent truth, if not a recognition of the importance of a myriad of them, do exist. For example, Guesnerie & Woodford, (1992) look at 'sunspot solutions' in which an expectation becomes the truth (and thus entirely cognitively correct and rational) when everyone believes it.

More broadly the treatment of cognition within Economics (and the processes behind decision making in general), is acknowledged to have developed somewhat slowly, as Simon (1986) puts it: "Economics without psychological and sociological research to determine the givens of the decision making situation, the focus of attention, the problem representation, and the processes used to identify alternatives, estimate consequences, and choose among possibilities -such economics is a one-bladed scissors". (p. 39-40). In response to such concerns there is now a rapidly developing branch of 'Behavioural Economics' trying, as it were, to build the other blade of the scissors (Wilkinson & Klaes, 2012). The point made in this thesis is rather tangential to this, however, as the intention is to explore the consequences of using one bladed scissors and to limit the harmful effects of using the wrong tool for the wrong job, as represented by the unwarranted foundational assumptions about cognition employed in the mainstream.

Although not well-represented within the Economics profession, rejecting the one-truth point of view and accepting that reality is contingent on our perceptions is a point of view that is

well established. Indeed, in the philosophical literature it has many forms, from general ‘anti-realism’ (Dummett, 1963), to more categorical forms of rejection of the independence of mind and world, as found in ‘idealism’ (Searle, 1995). In terms of the influence on my work it is the general approach of Postmodernism that has had most impact, however, and as a result this is discussed in some detail below.

Postmodernism is not popular amongst other Economists, as the comments by Foss (2006), below testifies, it is nevertheless a view of reality that chimes with a growing literature on the increasing complexity and turbulence of the Business environment, which has been observed since the 1960’s (Emery & Trist, 1965; Thompson, 1967; Terreberry, 1968; Johannesson & Palona, 2010). This has a number of implications for those of us charged with educating future participants in that environment, because if -to use the terminology of complexity theory (Blitz, 1992)- the environment ‘emerges’ from this complexity then it may not be reducible to its constituent parts and any concomitant single ‘truth’.

That it should be reducible is a central tenet of the dominant Methodological Individualist approach in mainstream Economics that holds that aggregate -social- phenomenon must be reduced to statements about individual action. In Economics the end point of this reduction - the point at which it becomes someone else’s field of study- has shifted from Psychology in general to those aspects of it not yet encompassed within the Behavioural Economics literature. This has allowed Economists to better explain observed behaviours (Camerer, *et al.*, 1997), but it has done little to challenge the belief that there is a real distinction to be made.

In contrast, in Clark (2003) I argue that knowing that there is a line, let alone knowing where to draw it, entails making an unwarranted assumption about the process of cognition. In particular that it is, to all practical effects, homogenous. To my mind this was an assumption that needed to be questioned, partly because it was unacknowledged in the literature, but mainly because my research suggested that it has undesirable pedagogic consequences (Clark, 2003). My motivation was not to primarily to join the ranks of the many critics of Methodological Individualism, but rather a reflection of my desire to improve teaching outcomes.

Methodological individualism comes in many varieties, but the unifying principle behind it is that aggregate objects, such as those dealt with in Economic enquiries, should not be treated as realities *sui generis*, but instead explained in terms of the actions of individuals, since individuals are independently definable entities with self-contained properties. These properties may be of interest to Economists, but they are not the subject of Economics *per se*. Consequently Economists have traditionally been happy to leave the study of this to psychologists, and are not necessarily perturbed if some Behavioural Economists chose to engage in such studies too. As long, that is, as their findings do not undermine the validity of actually making the distinction and thereby undermining what constitutes the proper study of Economics.

In contrast the argument that I develop in Clark (2003) suggests that the two spheres of world and mind are sufficiently intertwined to necessitate the making of a deliberate and explicit choice about where to draw the line to suit each and every economic enquiry. A parallel argument is also made in this paper in terms of individual power and its antithesis; environmental determinism, since this reciprocity works outwards as well as inwards. I do

not claim, either here or in that paper, that I am the first to appreciate that the reciprocal, dialectical, relationship between the parts and the whole means that we cannot simply sum the independent human elements together to get the big picture. Indeed, many of the debates in Macroeconomics revolve around this; for example Keynes' 'paradox of thrift' (Keynes, 1936), is a well-known case where a degree of independence is claimed for the aggregate phenomenon, that can actually be traced back as far as the 1700's (Nash & Gramm, 1969). What I am claiming is that there is both originality and utility in my identification of the way in which the reductionist approach in Microeconomics deflects attention away from the heterogeneity of real-world cognition.

That there are epistemological differences emerging from these different views is unsurprising, since an ontology that takes individual elements as self-contained leads us to interpret the search for knowledge in terms of getting away from complexity, while one that sees those elements as part of a system of relations will tend to push us towards it. What is not so obvious, however, is how these epistemological differences create a divergence in the extent to which cognitive heterogeneity is taken as legitimate and in the extent to which it matters in determining outcomes and, therefore, what and how we teach.

Acknowledging this means that even if we persist with the desire to reduce complexity to simpler, individual, elements we would have to concede that what we are trying to reduce it down to; the 'microfoundations' (Weintraub, 1977), may not entail convergence on the predictions of our theory, or 'model'. Instead, we would have to concede, and consequently teach, that the answers depend on where we draw the line between reality and expectations, with different perceptions of the same data (model) resulting in different stable and permanent outcomes, (rather than errors and perturbations that will -through market

adjustments or government actions- ultimately be corrected). Indeed, if we see the world as created in this way by our perception of it then the very existence of the distinction that orthodox Economists draw between Economics and Psychology is called into question (Clark, 2003). Furthermore, this pliability suggests that differences in perception become one possible explanation for some of the things we observe in the economic world, including aspects of enterprising behaviour (Clark, 2009), which the orthodox approach has struggled to explain (Baumol, 1968 & 1993). It is my contention, therefore, that understanding this has been hampered within the Economics orthodoxy by the drawing of what is, in fact, a somewhat arbitrary demarcation line that elsewhere has been largely erased. In psychology, for example, Karl Weick (1979) coined the term 'enactment' to describe the processes through which people construct organisational realities, while in sociology authors such as Harold Garfinkel (1967) have built an extensive body of literature on how people actually go about constructing the social world on a daily basis.

Although both Weick and Garfinkel have done much to promote the constructed view of reality, the debate between choice, (in its many guises; enactment, constructivism, voluntarism, and so on), and determinism (and all its variants) is an ancient one. It appears in a slightly different guise in the management literature too, since the debate therein was largely framed by reference to the dominant, environmentally deterministic, structure-conduct-performance approach that developed within post-war Microeconomics. This was challenged by authors such as John Child (1972), who showed that business strategy was often more to do with the 'strategic choice' that people make, than was acknowledged in the Economics literature. While Clegg and Dunkerley (1980) argued that this was a feature of many strands of organisational studies at the time too. In both fields it can be traced back to a common root in the biological analogy developed by Marshall (1890), wherein the industrial

environment is depicted as picking winning strategies in the same way that niches were depicted as determining species in early interpretations of Darwinian evolution. This assumption later became taken as an article of faith by the likes of Friedman (1953), and Machlup (1974), in mainstream Microeconomics, but can also be found to varying degrees in recent departures from the mainstream, such as the ‘ecological’ approach of Hannan & Freeman (1989) and the ‘evolutionary’ approach of Nelson & Winter (1982).

Concomitant with what I shall summarise as the alternative ‘enacted’ view, is that all manner of complex feedback and feedforward effects allow even subtle differences in cognition to have profound effects on economic outcomes. Indeed, in one of my books (Clark, 2000), I demonstrate how such reciprocity can allow a miniscule change in expectations to move an otherwise deterministic model from a state of predictable equilibrium to a state of unpredictable chaos. This is a simple example based on house prices but more complex versions with similar implications have been developed which can be applied to a variety of feedback types (Bastos de Figueiredo *et al.*, 2002).

The ability of people to create, or enact, the environment has a profound effect on what we teach as it suggests a much more significant role for perceptions than was evident in the teaching observations that I carried out in the early 1990’s, or as found in WinEcon (see papers one, two, and three). One such consideration is students’ own perceptions of economic actions and how these relate to those of the Economics profession who are there to teach them about it. This is an issue that carries across the first three papers, but is also a key feature of the later papers too. From the papers on WinEcon onwards, studying this revealed that Economists seem largely unaware of the tensions this creates in terms of misunderstandings about Economics as a subject (Dahlgren, 1984) and, I argue,

misunderstandings about the nature of strategic action and how Economics fails, therefore, to equip students to deal with the increasing complexity and uncertainty of the Business world.

In the sixth paper (Clark, 2010) I develop my thesis in this respect by investigating whose expectations most closely match the truth in a small number of cases. I relate this back to the methodology of Microeconomics by focusing on SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, since this is a pedagogic device developed to inform strategy by combining the views of the aforementioned structure-conduct-performance approach, with the views of those trying to escape from it (Learned *et al.*, 1969). This suggests that the different views should be in some form of competition in the teaching of SWOT, when in fact my research suggests that tutors are unwilling to take any outcome this competition results in, preferring instead some balance: Refusing, in other words, to depart both from either cognitive homogeneity or environmental determinism, and through their failure to explicitly acknowledge this, confirming my assertion that these are assumed.

So, although paper six (Clark, 2010) can be criticised for not being directly about economic pedagogy it illustrates that one of the main modern pedagogic evolutions from the crude determinism of 1950's Economics still retains some of the hallmarks of its genesis. A key related question is that if perceptions are enacting the world then where does creativity lie? This is crucial in my thesis because I view it as the type of activity that Economists should lay the foundations for if we are to prepare our students for an increasingly turbulent environment, and because it is so poorly understood within the subject area. This is not to say that Economists ignore it. However, in the mainstream it is generally treated as exogenously determined (Emmett, 1999), although the aggregate level of it is something that those associated with the heterodox Austrian school have shown much interest in, following the

pioneering work of Schumpeter (1950), and all manner of correlations between innovation and industry structure have been recorded in the mainstream (Acs & Audretsch, 1990).

The failure to incorporate it has been recognised as a problem, however, since creativity is the defining features of the entrepreneur, and -as Baumol (1968) acknowledged- when it is expressed in these terms it begins to look like a rather serious omission:

“The theoretical firm is entrepreneurless -the Prince of Denmark has been expunged from the discussion of Hamlet” (p. 66).

And, despite some furore over his comments, enterprise is still largely absent in orthodox Economics, as later work by Baumol (1993) suggests, and as a recent study by Johansson (2004) of Ph.D programs and textbooks in Economics, confirms.

In an attempt to help remedy this and make Economics more relevant to students of Business and Enterprise in the fifth paper (Clark, 2009), I demonstrate how abandoning cognitive homogeneity allows us to reveal the role of differences in perception in creativity and, therefore, in enacting some degree of economic change. I focus on invention in this paper as an example of creativity that can be directly related to a difference in perception and can – within the period of a degree- become an officially recognised enactment within the Business environment. Moreover, it is one that can then be easily fed back into the pedagogic process both through teaching and through students’ interaction with the artefacts created.

Leading on from this, in the seventh paper (Clark, 2013), I demonstrate that the differences in perception that give rise to invention are not exceptional, which suggests that my thesis has some claim to generality.

Contribution to knowledge; recommendations and implications.

In practical terms the contribution of this work is threefold. Firstly, there is a contribution to our understanding of the relationship between the teaching of Economics and its underlying methodological assumptions. Secondly, there is a contribution in terms of improved pedagogy and the extension of Economic pedagogy into new areas. Finally, there is a contribution in terms of the effects on students, manifest in terms of the development of new products, the engendering of a more entrepreneurial mind-set, and the ability to recognise a greater range of strategic options.

The initial and continuing motivation for this programme of research is the desire to improve the learning outcomes of students studying Economics as part of their Business Studies (or Enterprise) degrees. The number of students currently on such courses exceeds 350,000 (HESA, 2011). The majority of these students will be encountering Economics as part of those studies, which means that about ten times as many students will encounter Economics in this context than as part of an Economics degree (*ibid.*). It seems entirely justifiable, therefore, to focus on the needs of this large -and growing- group.

My desire in undertaking this research was to build a stronger bridge between Economics, which I take to be the study of choice in context, and the needs of Business students to learn what choices may be preferable in different contexts. Moreover, I was keen to achieve this without recourse to cognitive assumptions that restrict choice and understate the effect that cognition has on outcomes, since as Loasby (1976) argues: “To be worth studying choice must be meaningful and this implies first, that choice is genuine, and second, that choice matters” (p.5).

I felt this was worth doing as at an early stage in my teaching career I was struck by the fact that poor results in exams, lack of motivation, and a widespread failure amongst students to appreciate the relevance of Microeconomics, meant that it was unlikely to provide any foundation for the strategic Business choices they might need to make in their chosen career. This is why, despite many years of turning out Business graduates with a significant exposure to it, the “whole subject of microeconomics has made hardly any impact on business behaviour” Kay (1993, p74). As a result I feel that the contribution of my work needs to be evaluated in terms of how it has improved students engagement with Economics as well as in terms of the validity of the thinking that lies behind it.

It is important, therefore, to bear in mind when reviewing the pedagogic recommendations in all the papers presented here both my desire to address both poor outcomes and my desire to identify the restrictions that Economic assumptions impose. In doing this it is important also to appreciate that the recommendations in the papers entail changes that encompass both what is taught and how it is taught. Specifically, three major shifts in emphasis have resulted from abandoning the unwarranted cognitive assumptions that are covered herein in all the papers from the fourth (Clark, 2003), in which this issue is identified, onwards. Firstly, there is a shift in emphasis towards case studies and their interpretation and reinterpretation as the course unfolds. Secondly, there is a shift in emphasis towards action and strategy, and how these are informed by the different interpretations revealed by the analysis of the case studies. Finally, there is an added emphasis placed on uncertainty, ambiguity, and how to respond to this, in particular how to develop creative solutions.

There are of course additional differences that do not span the whole, but relate to the specific recommendations of the individual papers: For example, a different approach to teaching SWOT (Clark, 2010), the mapping of the innovative content of products (Clark, 2009), and assessments of students' perceptions and mind-sets (Clark, 2003 and 2013). In terms of behaviour this has an obvious link that we can gauge by the extent to which our graduates are subsequently willing to use what they have learnt and engage with Microeconomic concepts and tools. That I have had some success in this is evidenced by the fact that we have had spinout companies based on the work done in these classes with former students who have been willing to come back and share their experiences, and discuss what they found useful in the course, with subsequent cohorts. Allied to this there is also my own experience in Business, with the development of a successful social enterprise and in the increasing demand for my services as a strategic adviser to Business and governments.

At a more theoretical level there are, in addition to the papers presented here (and their associated conference papers), a number of textbooks and other instructional material that have been developed in connection with the courses referred to herein, as well as some collaborative projects being undertaken that have been initiated by other researchers reading and responding to the content of the papers.

Finally, there is the purely academic contribution, which while difficult to disentangle from the teaching implications, is what I attempt to explain below and which forms the justification for the pedagogic recommendations of each paper. In this there is, of course, the influence of individual papers, some of which have been very well received with other

researchers pursuing individual themes therein, but also a broader overarching message for Economists. That the message is a challenging one to orthodoxy thinking means that it has had to be supported by a mini lecture tour. However, both this and discussions of the papers at conferences, and with journal reviewers, have been broadly favourable although for some it represents an unwelcome move towards Postmodernism, which is discussed and defended in more detail below.

In explaining the overarching themes of my thesis I would like to emphasise both the originality of my critique and the constructiveness of my approach, as although there are plenty of authors willing to criticize Economics (Monaghan, 2003), my work is the only example where the explicit links between methodological assumptions and teaching outcomes are discussed, and in which a number of ways of rectifying them are suggested and tested in a systematic manner.

The origin of the work was the aforementioned teaching observations which raised many questions in my mind regarding the teaching of Microeconomics, particularly with regard to the needs of Business students. However, it was the advent of the computer package WinEcon that allowed me to delve most easily into the shared assumptions of contemporary Economic pedagogy. WinEcon had the advantage of being easier to summarise quantitatively than teaching observations, but was nonetheless also representative of teaching practice at the time as it combined the work of a number of leading Economics departments and was specifically designed to be a teaching package.

Following the publication of the WinEcon papers the authors worked with the system producers (the Teaching and Learning Technology Programme), on a project aimed both at improving WinEcon and creating a derivative specifically designed for Business students, and although in the end this never materialized (for reasons that were beyond our control), WinEcon has evolved considerably since then in ways that reflect our recommendations. Today there are a range of tools and modules now available at Winecon.com that reflect a more flexible approach and an element of response to some of the specific recommendations we made in the increased emphasis on the complementarity of WinEcon to other teaching resources, rather than its substitutability.

The main recommendations from the studies of WinEcon relate to pedagogic practice, but all stem from the same denial of real choice that I had witnessed in my teaching observation. The implication to my mind was that there was something about mainstream Microeconomics in general which encouraged a transmission approach and a circumscriptive view of the scope for genuine strategic choice. The two tend to go hand in hand since taking choice seriously allows for the existence of a far greater number of permutations that may make it difficult to get a given message transmitted in a given time.

That does not explain, however, why a more environmentally deterministic message was being adhered to when the evidence was turning against it and in favour of the significance of choice, as discussed in more detail in the next section. To my mind, while there may be many factors -such as habit- that play a part in maintaining it, the attachment is much deeper than such things imply because it stems from a foundational –methodological- assumption.

Specifically, I concluded in paper four (Clark, 2003), that it was the assumption of cognitive homogeneity that served to deny choice and thereby objectify context and impose an element of determinism that may not be warranted by the evidence. In fact, on reflection, I think that this paper understates the case as I tend now to see this as something of a metanarrative, since it entails a set of beliefs that are applied unquestioningly in the classroom. Partly this reflects the state of Economic theory, which continues in the main to laud mathematical tractability. This calculability criterion necessitates the use of assumptions that emphasise the degree of shared rationality rather than the heterogeneity of agents within the model, since the former simplifies matters while the latter complicates things in unpredictable ways by blurring the line between the endogenous, unobservable, mind and the exogenous factors in the model (Clark, 2003). In a recent attempt to push the other way Heathcote *et al.*, (2009) describe exactly this type of problem; “in building microfoundations for a model of individual heterogeneity, where do we draw the line between exogenous factors beyond the individual's control and rational choices?” (p. 11).

The adoption of the assumption of cognitive homogeneity can be seen, therefore, as a matter of convenience as much as any active methodological choice; since all models are abstractions it seems little more than common sense to put aside the consideration that can be legitimately ascribed to someone else's subject matter. However, my conclusion from the survey research presented in paper four (Clark, 2003), as well as the prior teaching-observation work, and the preceding dissection of WinEcon was that assuming cognitive homogeneity has pedagogic implications that need to be assessed and, in my view, revised if we see the value in improved outcomes for our students as outweighing any losses incurred by its abandonment.

Consequently, whether we are getting the balance right on this needs to be continually assessed in practice and, as with all the papers presented here, in paper four (Clark, 2003) there is a large element of reflection on the implications of this for teaching practice, as well as an element of action research to facilitate some iteration between theory and recommendations for improvements in pedagogic practice. This is supported by the action research of others in the University of Glamorgan's affiliated colleges and internationally through dialogues with other academics through bodies such as Edineb (Educational Innovation in Economics and Business; www.edineb.org), and Crea (Creativity European Association; www.creaconference.com), as well as from responses to the published papers and the associated verbal presentations.

A specific action that I began to take in preparation for paper four (Clark, 2003), was to develop a pedagogy in which different interpretations are explored (and deconstructed), with more attention given to the impact of different interpretations, both as factors in explaining what actions were taken in different cases, and also in framing subsequent reflections by students upon those actions. This provides a relatively rigorous background to strategy that is empowering and which resulted in consistent and sustained improvement in student outcomes and levels of engagement with Economics, as some survey work reported in paper four suggests (Clark, 2003).

Giving more weight to interpretations also helps students recognise the value of the exploration of such differences in Business (D'Aveni and MacMillan, 1990). It is more than

that, however, since it underlines, rather than undermines, the legitimacy of different perceptions, even those of the relatively inexperienced student, since teachers don't always know best, as paper six (Clark, 2010) shows. This paper is considered here before paper five (Clark, 2009), as it was primarily devised as part of my research into testing the resilience of the unwarranted assumptions that I identified in paper four. As SWOT represents a synthesis that encapsulates both the deterministic thesis and its antithesis (strategic choice) I felt that looking at how it was taught would be useful for both pedagogic practice and to help shed further light on the extent of the reach and depth of the attachment to determinism.

Analysing SWOT allowed me to broaden my conclusions and recommendations as SWOT is ubiquitous on Business Studies courses. I concluded from this research that my hypothesis had merit, since the pedagogy of 10 tutors employing SWOT served both to limit the scope for different interpretations and was at odds with the interpretation of the majority of entrepreneurs in the study. It was, therefore, of limited value in providing either a foundation for strategy, or in developing the ability of students to interpret events in the way that the entrepreneurs in the study did.

The implications that I drew from this regarding the link to cognitive homogeneity was supported by the regression results in the paper. This suggests that it was being imposed by lecturers (to some degree), since apparently divergent perceptions were found to be legitimate when contrasted with the evidence, but not so relative to the degree of homogeneity expected by tutors in their marking practices. The implication is that students run the risk of being discredited for holding an 'unbalanced' perception even if it was both correct and consistent with the perception of entrepreneurs.

This clearly has implications for my thesis since it confirms the link between the assumption of cognitive homogeneity and the assumption of a degree of environmental determinism that may be unwarranted by the evidence. All theories are simplifications of course, but when the reductionism relies on unwarranted simplifications then we have an issue with the assumptions we are making, and although the study only encompasses 10 tutors and 10 entrepreneurs, the depth of the analysis that was achieved was acknowledged by the reviewers.

In the fifth paper (Clark, 2009) I investigate the implications of removing such unwarranted assumptions from pedagogy in a very practical way by focusing on a measurable aspect of Business creativity; invention. The results were in part achieved by employing methods from ‘heterodox economics’ that seemed more consistent with my view of the effect of complexity and with my desire to build a bridge between Economics and creativity.

One might include anything outside of the mainstream in the term heterodox economics, but generally we think of recognised groups that constitute some kind of ‘school of thought’ that engage with the orthodoxy, but which emphasise its limitations, or errors. Heterodox schools most relevant to this thesis are those emphasising uncertainty and creativity, such as the ‘Austrians’ and the ‘Chapter 12 Post-Keynesians’, who like G.L.S. Shackle, take the uncertainty theme in Chapter 12 of Keynes’s General Theory (1936) to heart. Although it does not yet constitute a coherent school of Economic thought I would also include ‘Postmodernism’ in general in this list, for reasons outlined below.

I chose to focus on invention in the fifth paper as I felt this was a concrete example of a creative act intrinsic to enterprise that does not seem to be explicable within the mainstream Economic methodology that serves to deny the scope for such enactments. There are two original contributions to the sum of knowledge that resulted from this aspect of the work; firstly, there are the clear tangible outcomes of the invented artefacts and patents held by students. Secondly, there are the less tangible but nonetheless significant achievements in terms of student motivation and engagement, with new exciting tools of creativity -such as the BRAINERS model (in which directions of travel in product innovations are mapped), and creativity transfer- emerging from this work. Indeed, the originality of creativity transfer has been recognised by its inclusion in the current Bond University-Galileo study of key innovations in the Enterprise field.

In order to understand paper five (Clark, 2009) it is necessary to appreciate the impact of paper six (Clark, 2010), despite the fact that the latter paper achieved publication first, as in paper five I am effectively trying to make a finer distinction between context and choice by focusing on one aspect of the SWOT matrix, namely the Opportunities element. A complex set of ideas wrap around this word, but some difference can be discerned between those who see these as environmentally determined gaps and those who see them as being called into existence by our attention to them. This is not to deny that reality can vary, with both types co-existing in aggregate, but each one either exists out there, ex ante to any attempt to enact it, or it does not. Consequently our choices remain until such time as the whole choice set is known. Acknowledging such genuine choice also allows the term ‘opportunity’ to encompass genuine novelty, such as invention, since enactment implies an element of invention; “the outcome of organisational sense-making is not discovery but invention” (Schauster, 1995, p.1).

To investigate the pedagogy of actual invention, as in paper five (Clark, 2009), may seem to be taking this interpretation of enactment far too literally. However, it is an ideal type enactment as it makes perceptual differences tangible, since the idea must be verifiably unique to the individual student despite the context of its creation being shared with the rest of the class, or group. The idea of enactment is of course subtle and nuanced and in part only makes sense in contrast to some other view, such as determinism. Nonetheless, in a patent it can be personified in something that a student can actually point to as having an impact on the world; an enactment that is, therefore, empowering and yet can be informed by observing the patenting environment using standard microeconomic tools, such as marginal analysis, as in the BRAINERS model (Clark, 2009).

The success of this programme of teaching in generating new patents and ultimately new products confirms that a science of choice can be developed in areas that the existing approaches struggle to address and in ways that empower students. However, I was concerned that in drawing this conclusion I was overlooking the extent of the possible uniqueness of the cognitive processes behind it. As it is one thing to assume that cognition varies, it is quite another to assume that the variety needed for invention is typical of other Business activities. So, in the next paper (Clark, 2013), I tried to discern the extent to which the rarity of invention was simply indicative of a rarity in the type of cognition employed, which if true would make invention a rather biased test of my hypothesis.

Unfortunately, the evidence I needed to remove this doubt proved difficult to obtain, since it required me to investigate only those ideas that were validated as patentable, which took some time to accumulate. The sample size in paper seven (Clark, 2013) is, therefore, only 30,

but since this number of patents has never been observed in the creation phase before this seemed a reasonable number at which to start drawing some inferences.

Since in this paper I was addressing the issue of whether the cognitive differences that make a difference in the 'objective' realm are odd, the simplest approach was simply to ask those involved. In practice that meant asking everyone who thought they had had a good idea to fill out a brief survey, knowing that very few would subsequently prove to be original. The evidence collected in this way suggests that at the time of having the innovative idea students were content to describe it in terms that reflect well-researched and common cognitive processes. This was the main conclusion of the paper, however, much of the paper addresses the need to overcome the modernist assumptions in some psychology that serves to deny enactment and which, therefore, serves to support the Economics approach that I was critiquing. Such psychology:-

“still pursues the modernist agenda of cognitive reductionism (that) draws attention towards the structure of internal mechanisms while drawing it away from structure that emerges from the interaction between individuals and their environment. It is this internal emphasis that constrains psychological inquiry into the self. This constraint can now be eased as part of the shift in postmodern science”. (Griffin, 1988, p.44).

In allowing me to do my own such 'easing', paper seven (Clark, 2013), therefore serves a double purpose in my thesis, since the results confirmed my belief that the reductionist issues I had identified are not confined to Economics and that the solutions I was suggesting were not confined to some special kind of thinking, or person.

A significant amount of work in all the papers can be seen as testing specific pedagogic assumptions, which is a valid endeavour in itself, but the originality here is greater than that as I have demonstrated how these are fundamentally interrelated, as summarised in Figure 3, below. This work therefore represents a significant contribution to the sum of knowledge. However, my main motivation in writing these papers was to stimulate debate on the pedagogic changes that we were making at the University of Glamorgan and the subsequent success of the papers, books, conference presentations, and -having just been nominated for the University of Glamorgan students' favourite educator 'Golden Apple 2012' awards- the teaching, makes me feel that the emphasis on pedagogy was justified.

Figure 3: Summary table of papers showing linkages and implications.

Issue	Paper	Pedagogic Implications.
<p>Q. How is Economics taught?</p> <p>A. In a transmission approach.</p> <p>↓</p>	1,2,3	The poor engagement with economics in general and WinEcon in particular led to a number of practical suggestions and a re-think at Glamorgan about both CAL and the teaching of Economics to Business Studies students in general.
<p>Q. Why does a transmission approach dominate?</p> <p>A. Because of the assumption of cognitive homogeneity.</p> <p>↓</p>	4	Need for a different approach, based on taking choice seriously by allowing for different interpretations and for those interpretations to have strategic impacts, thereby improving the link between economics and proactive and purposeful strategy.
<p>Q. What are the implications of this assumption for students' strategic thinking?</p> <p>A. This assumption constrains the strategic and entrepreneurial thinking of students, as can be demonstrated even in a tool that represents an attempt to break free of the deterministic approach it engenders.</p> <p>↓</p>	6	Implications for teaching and assessment practices if we want to encourage students to develop enterprising strategies.
<p>Q. ↓ How does rejecting the assumption of cognitive homogeneity of a more proactive and strategically relevant Economics?</p> <p>A. Rejecting it allows an Economic approach that encompasses some aspects of Enterprise to be encompassed that otherwise cannot be.</p> <p>↓</p>	5	Allows an otherwise neglected aspect of economic creativity to be incorporated in the pedagogy.
<p>Q. Is the cognitive variation necessary to be creative (enterprising) sufficiently common to warrant the pedagogic shift envisaged?</p> <p>A. The evidence in this paper suggests that the cognitive processes behind enterprising behaviour may not be exceptional in themselves.</p>	7	This confirms that the pedagogy developed is generally applicable and that the assumption of cognitive homogeneity should be rejected in an Economics that is designed to underpin Enterprise.

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Appendix 1: ERA and ABS classifications

ERA classification of Journal Quality Standards

The following is copied from the ARC-ERA website (<http://arc.gov.au>)

ARC-ERA classification:

A*

Typically an A* journal would be one of the best in its field or subfield in which to publish and would typically cover the entire field/subfield. Virtually all papers they publish will be of a very high quality. These are journals where most of the work is important (it will really shape the field) and where researchers boast about getting accepted. Acceptance rates would typically be low and the editorial board would be dominated by field leaders, including many from top institutions.

A.

The majority of papers in a Tier A journal will be of very high quality. Publishing in an A journal would enhance the author's standing, showing they have real engagement with the

global research community and that they have something to say about problems of some significance. Typical signs of an A journal are lowish acceptance rates and an editorial board which includes a reasonable fraction of well known researchers from top institutions.

B.

Tier B covers journals with a solid, though not outstanding, reputation. Generally, in a Tier B journal, one would expect only a few papers of very high quality. They are often important outlets for the work of PhD students and early career researchers. Typical examples would be regional journals with high acceptance rates, and editorial boards that have few leading researchers from top international institutions.

C.

Tier C includes quality, peer reviewed, journals that do not meet the criteria of the higher tiers.

Not classified.

ERA includes journals that are peer reviewed but are below the quality threshold required for a C under this heading. This is also a catch-all category for new journals.

ABS Specification of Journal Quality Standards

The following is copied from the ABS website (<http://the-abs.org.uk>)

4*

World Elite Journals. There are a small number of grade four journals that are recognized worldwide as exemplars of excellence within the business and management field broadly defined and including economics. Their high status is acknowledged by their inclusion as world leading in a number of well regarded international journal quality lists.

4

All journals graded 4, whether included in the world elite or not, publish the most original and best executed research. As top journals in their field, these journals typically have high submission and low acceptance rates. Papers are heavily refereed. Top journals generally have the highest citation impact factors within their field.

3

Three rated journals publish original and well executed research papers and are highly regarded. These journals typically have good submission rates and are very selective in what they publish. Papers are heavily refereed. Highly regarded journals generally have fair to good citation impact factors relative to others in their field, although at present not all journals in this category carry a citation impact factor.

2

Journals in this category publish original research of an acceptable standard. A well regarded journal in its field, papers are fully refereed according to accepted standards and conventions. Well regarded journals have modest citation impact factors or do not have one at all.

1

These journals, in general, publish research of a recognized standard. They are modest standard journals within their field. Papers are refereed relatively lightly according to accepted conventions. Few journals in this category carry a citation impact factor.

Appendix 2: University of Glamorgan form R3a

R3a The Publications							
Period during which research was undertaken (1)	Authors as listed, title of publication, publication reference (2)	Refereed (Y/N)	ISSN	No of pages	Year of publication	Applicant's contribution (3)	%
01/97-01/98	D. J. Brooksbank, A. Clark, R. Hamilton, D. G. Pickernell (1998) A critical appraisal of WinEcon and its use in a first-year undergraduate Economics programme. <i>ALT-J Research in Learning Technology</i> , Vol. 6, No. 3, p. 47-53. Published by ALT.	Y	0968-7769	P47-54	1998	72%	
01/97-01/98	D. J. Brooksbank, A. Clark, R. Hamilton, D. G. Pickernell (1998) Views from the Trenches; Lessons from the Introduction of WinEcon into a First Year Undergraduate Programme. <i>Computers in Higher Education Economics Review</i> , Vol 12, No 1, p. 13-19. Published by CTI Economics.	Y	1358-5363	P13-19	1998	40%	
01/97-01/99	Clark, A. (2001) What can we learn about computer-based learning from the Teaching and Learning Technology Programme's flagship product? <i>Innovative Approaches to Learning & Teaching in Economics and Business Education</i> . Ed: Peter Davies, SUP.	N	ISBN 897898 1 82 7	P99-109	2000	100%	
01/99-01/03	Clark, A. (2003) Methodological individualism, cognitive homogeneity and environmental determinism. <i>Journal of Economic Methodology</i> , Vol. 10, No. 1. p. 79-85. Published by Routledge.	Y	1350-178x	P79-85	2003	100%	

01/05-01/08	Clark, A (2009) An experiment in teaching invention. <i>Education and Training</i> . Vol. 57, No. 7, p. 516-525. Published by Emerald.	Y	0040-0912	P516-526	2009	100%
01/08-01/09	Clark, A (2010) Educators vs. Entrepreneurs: Traits and bias in the teaching of SWOT. <i>Journal of Further and Higher Education</i> . Vol. 35, No. 2, p.1-14. Published by Routledge.	Y	0309-877X	P287-298	2011	100%
01/06-10/10	Clark, A (2013) De-mystifying inventive thinking. A survey with pedagogic implications <i>Journal of College Teaching & Learning</i> . 10(1). (C).	Y	1544-0389	P13-22	2013	100%

Paper 1

Brooksbank, D. J., Clark, A., Hamilton, R., & Pickernell, D. G. (1998a) "A critical appraisal of WinEcon and its use in a first-year undergraduate Economics programme". *ALT-J Research in Learning Technology*, 6 (3): 47-

A critical appraisal of WinEcon and its use in a first-year undergraduate Economics programme

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This is an extended review of WinEcon, a CAL package for introductory economics. Our comments are based on a survey of staff and students involved in the first large-scale (n = 300+) attempt to integrate WinEcon into a teaching and assessment programme.

The WinEcon project

WinEcon is a Windows-based introductory Economics CAL package designed for use in higher education. It is the product of the Economics Consortium of the TLTP (Teaching and Learning Technology Programme) consisting of eight university Economics departments. Each of these has been responsible for producing some of the 25 chapters (tutorials) of the finished product. Content is based on covering the common core of introductory Economics as revealed by a survey of higher-education Economics departments. WinEcon is provided, with an accompanying workbook, for a nominal registration fee in the UK. The package is important insofar as it is aimed at all first-year undergraduates studying Economics, which encompasses not only those taking straight Economics degrees but large numbers of students following introductory Economics as part of a Business Studies or Combined Studies course. With no competition to speak of, WinEcon is likely to become a significant feature of the learning experience of a large tranche of the undergraduate population, across a number of degree schemes. Indeed, for many of these students WinEcon will constitute their first major experience of CAL.

Integrating WinEcon

It is intended that WinEcon, like all TLTP products, should be integrated into teaching programmes to such an extent that it becomes an indispensable learning resource. Although, as Jacobs (1996) points out, TLTP products have had less success in this aim than was hoped, we decided from the outset to give WinEcon a central role in our curriculum by locating it within a cycle of 'wanting, doing, feedback, and digestion' (Race, 1994). The initial motivation would come from our pioneering use of WinEcon's

assessment facilities. 'Doing' would consist of weekly WinEcon sessions with feedback provided by both the students and staff, and 'digestion' would be assisted by fortnightly discussion sessions.

Our evaluation of this trial is based on bench-marking WinEcon against the claims of its authors and against our belief that CAL can result in economies in the production of learning and improvements in the quality of learning. Our comments are based on the experiences of four members of staff, the results of a questionnaire of over 300 students at the end of their Introductory Economics course, and a number of discussion sessions with a smaller group. The research is continuing since it forms a part of a wider on-going programme of monitoring students' learning experience at Glamorgan.

Economies in the production of learning

The claims of the producers of WinEcon regarding its potential to reduce the burdens of paper-based assessment and to replace (rather than just complement) staff-led seminars is likely to be a factor in its adoption given increasing workloads in higher education. After some trials and tribulations, the package has now been successfully integrated into our assessment programme. However, on the second of our envisaged economies – the substitution of staff by machine – our experience leads us to doubt whether WinEcon can live up to its claims since 90 per cent of our students felt that a lecturer needed to be present when using the package. This finding suggests limitations in the type of learning WinEcon provides, and it is the learning issues we wish to focus our attention on in this review.

Improved quality of learning

We believe that CAL has the potential to enhance the learning process in three main ways: first, by providing stimulating visual interaction; secondly, by allowing learners to manage the learning resource, and thirdly, by increasing the variety of learning environments available to students. As before, it is in terms of these expectations that we are bench-marking WinEcon.

The expectation that WinEcon would provide stimulating visual interaction for learners of a fidelity not possible with 'chalk and talk' is based on two observations. The first is that it can be done: we have seen stimulating visual interaction in earlier economics CAL packages (for an inexpensive example, see Hall and Taylor, 1986). The second is that it is the avowed intention of the producers of WinEcon to do it, as they make clear when referring to the need to avoid producing a program in which 'the computer is merely an electronic page turner', which is to be achieved by incorporating 'some specific element of interaction on each page' (TLTP, 1993, p. 3). Otherwise our enthusiasm for CAL packages such as WinEcon is likely to be short-lived, as it will have been founded on nothing more than 'the sexiness of the computer to make page turning software more compelling' (Feifer and Allender, 1994, p. 197).

As the issue of interaction is crucial to defining what WinEcon provides in this respect, we decided to assess what we had used (primarily, but not exclusively, the first six chapters) page by page. We found that 60 per cent of pages had no interactive content, consisting entirely of a block of text; 17 per cent had interaction in the form of answering a question; 12 per cent had interaction to the extent that the computer draws a line or moves something (although this is perhaps better described as a demonstration rather than an interaction). Less than 7 per cent have either named examples, cases, or the opportunity to

dig deeper, using 'More' or 'Advanced' options. One per cent of pages contained background material on key thinkers. Over 1 per cent of pages have drag- and point-type interaction, but an equal number of pages have an apparent interaction that actually results in an additional block of text. There are a few interactive simulation exercises, but not of the modelling sort; rather they correspond to what Moyse (1991) refers to as the 'task-action-mapping' type, that provide 'a list of control movements which would achieve operational goals'. This can lead to students hunting for the right number rather than learning the model on which the simulation is based. The lack of simulations and their *modus operandi* in WinEcon is a disappointment as simulations are one of the primary means by which computers can be used to provide experiential learning. To summarize: there are many pages in WinEcon where the students' role is entirely passive, and the bulk of the remainder provides only very limited interaction. The lack of interactivity of WinEcon was also highlighted by students: 45 per cent did not feel that it was interactive enough to keep them interested, and 53 per cent did not feel that it was more than a computerized book. Despite their intention, our conclusion is that the authors have produced something akin to an electronic page-turner. This is a lost opportunity, the price of which is the need for more plain text, for as Somekh (1996) argues: 'The more interactive the software becomes, the more it is possible to allow learners to learn by exploring models, or building models, rather than by digesting text.'

This observation raises the issue of whether the computer screen as a medium for a textbook is preferable to the printed page. The answer is probably no, as it is harder to read large blocks of text on a screen than on a page, so the screen 'is not best used to offer initial teaching, unless it can be expressed in few words and simple diagrams' (Laurillard, 1993, p. 149). In addition, if too many words appear on a screen there is 'an observable tendency in students to ignore it, or to become impatient with it' (ibid., p. 151). Our research suggests upper limits in the tens rather than the hundreds, and this is consistent with what WinEcon provides. This means, however, that the student gets fewer words than has previously been considered necessary to convey the same message, at the same level, in a textbook, and that WinEcon does not have the breadth of leading general introductory texts either. This constraint may also explain the lack of real-world examples and case studies in WinEcon. Another drawback in comparison with a printed textbook is that WinEcon is less portable as the pages cannot easily be printed off, so that for revision purposes many students felt it necessary to buy the accompanying book.

In addition to problems with presenting a textbook on a screen, there are problems with the approach adopted to the writing of WinEcon, insofar as, unlike a standard textbook, many authors were involved. This has created a lack of uniformity in the text, with significant differences in the amount of interaction and the degree of content difficulty in different sections. These differences seem more indicative of the inconsistencies that can arise in attempting to co-ordinate the work of many authors than of deliberately planned changes in pace or pedagogic style.

Our second route to improved learning through CAL comes from its ability to enable students to manage their learning resources, by providing a learning experience that can be revisited until the desired level of understanding is reached. However, to control their learning effectively, students need to know how ideas link together, which topics are important and why, what learning (rather than just what topic) is a prerequisite for what,

and what the learning objectives are. None of these is a feature of WinEcon. This may be a sin of omission, but it could also be that, with few words to play with, making links may have been seen as a luxury that the authors could not afford. It would then be an understandable, but none the less significant, sin of omission, and would, again, be indicative of the difficulties entailed in putting a textbook on a screen. It may also reflect the fact that with many authors working in relative isolation, the co-ordination of ideas may have become onerous. In addition, the lack of interaction in WinEcon means that the only effective control students have over their learning is to adjust the pace at which they work through the text. This is a type of control, but it does not involve the level of control and of mutual re-adaptation that experienced teachers use in a tutorial setting. So, although WinEcon is referred to as a tutorial system, what it provides does not equate to our current tutorial practices, or the definitions of such that are used in educational literature. For example, for Laurillard (1993, p. 152) the key feature of a tutorial is adaptation, hence to imitate this a package needs to use 'the students' performance on previous tasks to decide what tasks should be set next, without which it is not a tutorial'. Programs that do this are often referred to as 'intelligent teaching programs'. Creating this kind of 'intelligence' requires not just subject knowledge but also an understanding of how students learn, an aspect of the production of effective CAL that we feel has been largely overlooked in the WinEcon case. These criticisms are supported by students' feedback, for despite the fact that WinEcon is referred to as a 'tutorial program', 81 per cent of students did not believe that it should replace classroom tutorials.

Our third reason for believing that WinEcon could lead to enhanced learning was that it would add to variety in the learning experience by providing something that might otherwise not have been available, given institutions' reluctance to invest in CAL. WinEcon lived up to expectations in this respect: it is colourful and well written, so that 57 per cent of students felt that it explained difficult topics well.

Finally, we envisaged the possibility that improved learning could result directly from the freeing of staff time that substitution by machine could produce, since this time would have been used for educational development. Although few such benefits have materialized as yet, we anticipate that benefits of this kind will do so in future as we (and the programmers of WinEcon) move along the learning curve in applying this package.

Conclusions

We found that WinEcon was welcomed as an additional source of information by students, but it did not provide the level of learner interaction or learner control that staff had anticipated, which – once the novelty had worn off – led to student dissatisfaction too. To understand its failings in terms of the learning process, we need to consider the pedagogical philosophy underlying WinEcon: the lack of interaction, the form of the interaction, the linearity of the discourse, and the overall pedagogical style of the package are indicative of a 'transmission of knowledge' approach to teaching, where unproblematic information – that exists *sui generis* – is transmitted to the receptive student, so that 'content knowledge and fluent presentation are enough for good teaching' (Ramsden, 1991, p. 116). This approach tends to play down the importance of barriers to learning, such as students' misconceptions, and largely ignores their *ex ante* understandings of topics, and how they integrate the information; in short, how they learn.

In contrast, we believe a well-designed package should reflect what has been learned about the way students learn, and be responsive to their current conceptions of the subject matter. As Laurillard (1994, p. 187) argues: 'it is impossible for teaching to succeed if it does not address the current forms of students' understanding of a subject'. This understanding will enable the author to engage in a dialogue with the learner and incorporate programmed responses to misconceptions if they arise. To incorporate all possible misconceptions in a computer program may seem an impossible task, but these misconceptions are not random, or necessarily extensive, as knowledge and understanding are constructed in well-researched psychological and social contexts. Moreover, the student interfaces with a relatively static body of knowledge at this level in Economics, in a process that is replicated in many institutions, and within the same institution time after time. The result is plain from discussions of shared experience among Economics lecturers: there are a few key recurring misconceptions that are encountered in teaching introductory Economics. Moreover, many of these have been identified in the educational literature (see, for example, Dahlgren, 1984). None of the main ones that have been identified are addressed in WinEcon, which may help to explain why so many students felt that a teacher's presence was needed when using it, and why heavy use was made of the teachers who did supervise the sessions.

The type of feedback provided by WinEcon is also indicative of the transmission approach in two respects. First, there is the predominant use of multiple-choice questioning, which is typical of the transmission approach as it serves to check that the message has been received. Such assessment is based on how much, and how accurately, information is known rather than what is understood, whereas a more student-centred approach focuses on what is understood and is typically assessed using case studies, reports, and problem-solving tasks. Using the typology of MacDonald *et al.* (1976) quoted in Somekh (1996), we argue that WinEcon seldom goes beyond the recognition and recall types of interaction, and thus provides little 'constructive' learning. Secondly, the feedback in WinEcon is of the 'No, because . . .' (or often just plain 'No') type commonly referred to as extrinsic feedback. The problem with this is that, again, it fails to address conceptual misunderstanding, as Laurillard (1993) argues. To uncover misunderstanding, intrinsic feedback is necessary as well, that is feedback that arises not as a description of the appropriateness of an input, but rather as the product of the interaction with the conceptual model to the extent that the learning process is conditional on that input. Learning is then experienced from interaction with the conceptual model being taught rather than descriptions of it.

We recognize that in the case of introductory Economics, the learning process cannot be individualized to the extent that the student determines what Plowman (1992) calls the 'path of disclosure', as this can obscure the prerequisite nature of consecutive ideas, and use of terms, in this subject area. However, as Entwistle and Ramsden (1983) show, teaching shapes students' approaches to learning, even their meta-cognitive strategies. So, to the extent that the student's approach to the learning process is malleable and conditional on the context, WinEcon will reinforce desires for a linear, non-discursive, approach. Indeed research with a sub-group of students employing a deep-learning approach (cf. Marton and Saljo, 1976; 1984) showed that they became more dissatisfied with WinEcon than other students, and tended to resort to flicking through pages. This lack of interest is atypical of such a group whom we would expect to engage relatively

deeply with the subject matter and maintain high levels of interest, and academic success (see van Rossum and Schenk, 1984; Trigwell and Prosser, 1991; Watkins and Hattie, 1985).

Our responsibility in conducting this review is to appraise the likely returns to investing in WinEcon, for although it is essentially free of charge to users, we must consider the time, effort, and associated opportunity costs, as time spent using WinEcon is time not spent engaged in other learning activities. In doing this, we recognize that CAL is not a panacea for all teaching in the future. None the less, we have to report that both staff and students found WinEcon uninspiring. This is a pity, since for many students it means that their first major experience of CAL is unlikely to be a happy one.

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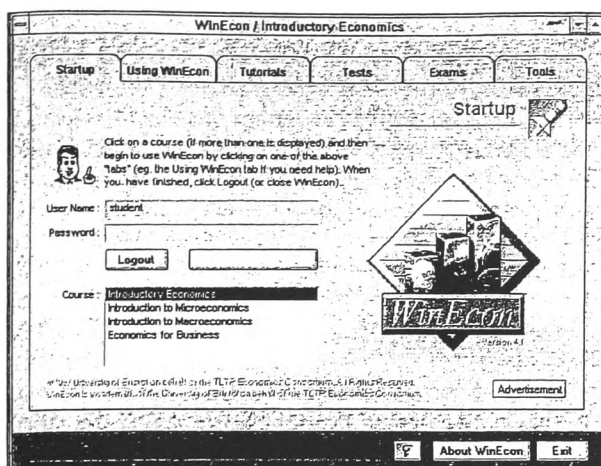
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Paper 2

Brooksbank, D. J., Clark, A., Hamilton, R., & Pickernell, D. G. (1998b)
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Views from the Trenches: Lessons from the Introduction of WinEcon into a First Year Undergraduate Programme

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Abstract

This paper reviews Glamorgan Business School's introduction of the WinEcon Computer Aided Learning (CAL) package into its first year microeconomics module. The comments, conclusions and recommendations are based on a survey of academic staff involved in teaching using WinEcon and questionnaire answers from nearly 200 Glamorgan students who actually used the package. Conclusions reached were that WinEcon was unlikely to completely replace classroom tutorials or prove completely satisfactory as a textbook / workbook without additional work to customize it to the needs of the specific course, but that it did offer a useful addition to more traditional teaching methods in an integrated learning programme.

Introduction

This study builds on work in this journal of Crichton (1995), evaluating the utility of the Computer Assisted Learning (CAL) package, WinEcon, as a replacement for classroom based tutorials and as a computerized workbook. Through the piloting process student experiences were also used to design the most effective framework in which to utilize the package. This paper reports on data gathered from academic staff involved with teaching on the course and questionnaire output derived from nearly 200 students who used the package (see appendix).

Glamorgan Business School has seen a rapid increase in the number of students undertaking the basic course in microeconomics (from about 160 in the previous year, to over 300 in the year in which WinEcon was introduced).

Our primary concern was to consider ways in which the package could be used to provide more effective learning in first year microeconomics and we treated the introduction as a piloting exercise in which WinEcon could be thoroughly evaluated. To conform to these aims we adopted the following structure as a cautious first step:-

- A weekly lecture
- A weekly CAL laboratory session
- A fortnightly classroom tutorial session to reinforce the lecture and CAL material.

This set up replaced the previous regime of a weekly lecture and weekly classroom tutorial. The first six microeconomics chapters of WinEcon were used as the basis for the module and the lectures were written to follow the structure of WinEcon, whilst tutorial questions were 'stand alone' and designed to reinforce material encountered on WinEcon. We envisaged that WinEcon would provide additional explanation to topics covered in lectures (and lecture notes provided) and sufficient interactive examples to aid understanding of both lectures and tutorials.

The software was used in weekly laboratory sessions as a supplement to a standard lecture and a fortnightly tutorial. A tutor was assigned to each laboratory session, although after the first few weeks this became a support role where tutors would provide advice if there were problems and would be 'on call' rather than in the laboratory itself for the full hour. The piloting process was therefore designed to assess the best way to utilize the package within the constraints of the module, examining its utility as a substitute for classroom tutorials and as a workbook / textbook, and using students feedback to design the most effective teaching framework for the module in which to use WinEcon.

WinEcon as a Tutorial System

To test the assertion of Crichton (1995) that :-

"it is envisaged that WinEcon will replace seminars/tutorials"

we first examined the ability of the package to act as a 'tutorial'. For Laurillard (1993), the key feature of a tutorial is adaptation, which means that :-

"the program uses the students' performance on previous tasks to decide what tasks should be set next, without which it is not a tutorial" (ibid. p152).

WinEcon does not adapt to the individual in this way. Given the large programming task that would be involved this is perhaps not surprising. The relative interactivity of the package was also scrutinized. Members of the Teaching and Learning Technology Programme (TLTP) (1993) themselves argued that a well-designed course should aim to utilize some specific element of interaction on each page. Otherwise the enthusiasm for WinEcon would be founded on nothing more than :-

"the sexiness of the computer to make page turning software more compelling".
(Feifer and Allender, 1994 p197).

The issue of interaction therefore seems crucial in determining what CAL packages such as WinEcon provide. We began by examining the first 6 chapters of WinEcon page by page for interactive activity provided and found that 60% of pages had no interactive content, consisting entirely of a block of text. 17% had interaction in the form of answering a question, and 12% had interaction to the extent that the computer draws a line or moves something, (although this is perhaps better described as a demonstration rather than an interaction). Less than 7% have either named examples, cases, or the opportunity to dig deeper, using 'More' or 'Advanced' options. 1% of pages contained background material on key thinkers. Over 1% of pages have drag and point type interaction but an equal number of pages have an apparent interaction that actually results in an additional block of text.

To summarize, there are many pages in WinEcon where the students' role is entirely passive and the bulk of the remainder provides only very limited interaction. The only real control the student has over their learning is to adjust the pace at which they work through WinEcon, which does not involve the level of control, of mutual re-adaptation, that experienced teachers use in the tutorial setting. WinEcon thus comes across as more akin to an economics textbook that has been put on a screen, than a tutorial.

Questionnaire results supported this. 81% of students do not believe WinEcon should replace classroom tutorials and 90% do not believe it should replace lectures. Scrutiny of answers given for this revealed that students still wanted the contact with lecturers and tutors that WinEcon itself cannot provide. The relative lack of interactivity of the package was also highlighted by significant proportions of students. 45% of students did not feel that WinEcon was interactive enough to keep them interested and 53% of responding students did not feel that WinEcon was more than a computerized workbook.

Collective experience, gained from many years of teaching with a variety of CAL packages, means that we can rank WinEcon very highly in terms of graphical quality and technical content. However, it is clear from this work that more is needed to boost the 'interactive' aspects. Students quickly become disillusioned with page turning and reading blocks of text on the screen and we see a need to increase the amount that students actually 'do' when they are working through the material.

WinEcon as a Textbook / Workbook

In terms of using a computer screen as a replacement for a textbook, WinEcon does not have the breadth of leading general introductory texts and is, for example :-

"...less suitable for introductory business economics than for traditional economics principles courses"
(Sloman 1995, p. 1345)

This obviously needs to be taken into account when utilizing WinEcon within a business studies course. The problems created by the length of modular based courses in relation to the amount of information contained within a CAL package such as WinEcon also highlighted the need for guidance by staff in directing students to specific information and tasks within the package.

Whilst nearly 90% of students agreed that WinEcon gave flexibility to learn, the amount of material required to be covered in the module to give students an adequate grounding in the basics of microeconomics led 65% of students to believe that the course covered too much to use WinEcon effectively. This problem becomes acutely important when one considers learning styles. 75% of students believed they needed to take notes when using WinEcon. This may have contributed to nearly 60% of them agreeing that more than one hour per week was needed to keep up with the course. Indeed, the two were strongly, positively and significantly correlated at the 1% level, with a Pearson's correlation of 0.35.

Despite the flexibility of learning offered by WinEcon for students to learn at their own pace, 82% believed that they should have been set tasks by their tutor, rather than being left to move through the package at their own pace. Overall, the setting of tasks appears to be the most viable way of utilizing WinEcon to ensure that the important points in each topic are covered within constraints imposed by course structure and available resources. We reinforce the view expressed by Crichton (1995) that the number of tests (and types of test) need to be increased. As the development continues, the ability in the near future to use text string and qualitative data response questions will prove invaluable, not least because they will provide variety to the current multiple choice option.

Designing a Framework in which to use WinEcon

Despite these difficulties, however, only 22% of students wanted WinEcon abandoned from the teaching programme altogether. Responses indicated that most students felt that the package was useful as a learning aid, and that it should

be fully integrated rather than abandoned. Indeed, 87% wanted WinEcon fully integrated with the lecture and tutorial programme. 57% of students had enjoyed using the package as it presently stood, 60% continuing to use it to cover all of the economic topics in the module, and 57% found WinEcon explained difficult topics well, virtually all students finding it an easy package to use.

Full integration of WinEcon with lectures and tutorials would require particular focus on the tutorial programme, given that 45% of students did not feel it complemented tutorials, compared with 70% who felt it complemented the lecture notes. To examine this further we used a regression equation with the answer to whether 'WinEcon should be fully integrated' as the dependent variable. The independent variables were 'Course covered too much', 'WinEcon complemented lecture notes', 'I enjoyed using WinEcon' and 'Should have been set tasks by tutor'. The results are illustrated in Table I and suggest that the explanatory variables have some role to play. All are statistically significant at the 5% level and of the sign one would predict.

Variable :	Coefficient	Standard Error	T Value
WinEcon Complemented Lecture Notes	0.263	0.089	2.932
I Enjoyed using WinEcon	0.374	0.088	4.226
The Course Covered too much to use WinEcon effectively	0.209	0.092	2.285
I should have been set tasks by my tutor during WinEcon sessions	0.150	0.083	1.802
Constant	0.160	0.438	0.366
Adjusted R Square: 0.190 R Squared: 0.209 Standard Error: 0.732 F: 10.852 ¹			
¹ In addition the regressions were subjected to the usual barrage of diagnostic procedures, which they passed accordingly.			

Table I: Reasons WinEcon should be fully integrated with lectures and tutorials

Enjoyment in using the programme was particularly positive and significant in explaining the attitudes to full integration. It is obviously very important to enjoy using WinEcon, since full integration would require students to use the package to answer questions for classroom tutorials and prepare for examinations, rather than just as an aid in understanding concepts highlighted in lectures.

Since additional resources would be required to create the workplan / workbook to fully integrate the CAL package into the module, it is also necessary to explore and maximize the learning advantages that WinEcon could offer over more traditional methods. To examine this we used another regression equation, with students' responses to the statement "I enjoyed using WinEcon" as the dependent variable. The variables "WinEcon was more than a

computerized workbook", "WinEcon gave me flexibility to learn outside normal classroom hours" and "WinEcon was interactive enough to keep me interested" were the independent causal variables. The results are shown in Table II below:

Variable :	Coefficient	Standard Error B	T Value
WinEcon Complemented Lecture Notes	0.263	0.089	2.932
WinEcon was more than a computerised workbook	0.177	0.063	2.821
WinEcon gave me flexibility to learn outside normal classroom hours	0.551	0.062	8.857
WinEcon was interactive enough to keep me interested	0.199	0.061	3.262
Constant	0.118	0.228	0.498
Adjusted R Square: 0.443 R Squared: 0.452 Standard Error: 0.495 F: 48.272			

Table II: Reasons for enjoying using WinEcon

The three variables were positive and significant (at the 5% level), as intuition would predict. The strongest explanatory variable was that concerning WinEcon's interactivity. Essentially the more students felt that WinEcon was interactive enough to keep them interested the more they enjoyed using the package. When integrating the package with lectures and tutorials, lecturers could therefore guide students to the interactive parts of WinEcon and leave the "read and click" screens to the students' own time where necessary. WinEcon was also felt to give flexibility in learning outside classroom hours by over 85% of students and this was a positive significant influence on enjoyment of using the package. This is interesting and an important factor in favour of its continued integrated use.

The final factor, that WinEcon is more than a computerized workbook, is also important. The fact that just over half did not believe this to be the case may emphasize WinEcon's lack of interactivity. Overall, therefore, tutor guidance would seem to be needed to maximize WinEcon's interactivity, to maximize the enjoyment to be gained from using the package, and utilize advantages in terms of the flexibility which WinEcon offers (even if the programme is used outside normal hours as a computerized textbook).

Conclusions

There are three key conclusions to be drawn from this study. First, if our experiences are representative then simply adding a CAL package to a course replacing tutorials and / or lectures is not necessarily going to provide an instant solution to resource problems. It may ultimately save staff time, but it should not be seen as a 'quick fix' to such problems. In the case of Glamorgan's use

of WinEcon, no obvious reduction in staff-student contact time will be obtained from the new structure over the pre-WinEcon structure. However, it is hoped that a better educational experience will develop as students are expected to use their CAL sessions in an interactive way to gain the answers to questions, rather than passively obtain information from the computer, or indeed lecturers. This should also make the tutor's role more enjoyable in that the CAL sessions will involve explanation of economic models via the computer package rather than merely being at the front of a classroom, as in the classroom tutorials.

Secondly, integrating CAL packages into a course is likely to require significant "top loaded" work on the part of lecturers and tutors to be fully effective. It is unlikely that an "off the shelf" CAL package will perfectly fit the needs of any particular course and failure to undertake such work to properly integrate it will lead the package to be less effective. Thirdly, it is important to treat CAL as an addition to, rather than a replacement of, more traditional teaching methods such as lectures and tutorials. This is not to say that CAL packages cannot partially replace lectures or tutorials. However, full replacement has risks attached to it which will be unacceptable before a full evaluation of the CAL package has been undertaken.

Overall, it is believed that the introduction of WinEcon will have some long term benefits to the students undertaking first year microeconomics courses at Glamorgan Business School. It adds credence to WinEcon's claims to be an innovative teaching technique, albeit one requiring customization because of the needs and constraints affecting individual courses in individual institutions.

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Note The usual disclaimer applies and readers should note that the views expressed are those of the authors and not of the University of Glamorgan.

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Appendix

Questionnaire used and results obtained from it are shown below. Numbers in parentheses show percentage of respondents expressing each view, whilst numbers outside parentheses show absolute numbers of respondents expressing indicated view.

The Economy and Environment Course (BS101) used the new Computer Aided Learning Package WinEcon. In order to fully evaluate its usefulness we need your views on the package, the best ways to learn using it and the future use of packages such as WinEcon. This questionnaire has therefore been designed so that you can make your own experiences known. Please tick the box most appropriate to your views and add comments where you see fit.

Section A : Your experience of using the WinEcon Package

Please indicate the degree to which you agree or disagree with the following statements concerning your experiences of using WinEcon.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I enjoyed using the WinEcon Package	5 (2.8%)	98 (54.1%)	65 (35.9%)	13 (7.2%)
2. WinEcon was interactive enough to keep me interested	4 (2.2%)	96 (52.7%)	72 (39.6%)	10 (5.5%)
3. WinEcon was easy to use	44 (24.6%)	131 (73.2%)	4 (2.2%)	-
4. WinEcon complemented / added value to the lecture notes	18 (9.9%)	90 (49.7%)	71 (38.6%)	11 (6.1%)
5. WinEcon complemented / added value to the fortnightly tutorials	9 (5.0%)	90 (49.7%)	71 (39.2%)	11 (6.1%)
6. WinEcon explained difficult topics well	10 (5.6%)	92 (51.7%)	67 (37.6%)	9 (5.1%)
7. WinEcon gave me flexibility to learn outside normal classroom hours	33 (18.2%)	124 (68.5%)	21 (11.6%)	3 (1.7%)
8. WinEcon is more than a computerized workbook	6 (3.3%)	79 (42.9%)	87 (48.1%)	9 (5.0%)
9. (If purchased) The WinEcon workbook was useful	12 (11.0%)	30 (27.5%)	26 (23.9%)	41 (37.6%)
10. I used WinEcon to cover all six topics of the course	18 (9.9%)	90 (49.5%)	61 (33.5%)	13 (7.1%)
11. The course tried to cover too much to use WinEcon effectively	22 (12.5%)	92 (52.3%)	61 (34.7%)	1 (0.6%)
12. Please state below your overall impressions of WinEcon. How could WinEcon be changed to make it more useful?				

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Section B : Your Learning Style

Please indicate whether you agree or disagree with the following statements concerning the way you learnt using WinEcon

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I needed to take notes when using WinEcon to get the most out of it	33 (18.9%)	98 (56.0%)	39 (22.3%)	5 (2.9%)
2. I needed to use WinEcon for more than an hour a week to keep up with the course	26 (14.6%)	76 (42.7%)	70 (39.3%)	6 (3.4%)
3. I should have been set tasks to do using WinEcon by my lecturer/tutor	35 (19.6%)	95 (53.1%)	42 (23.5%)	7 (3.9%)

Please state below what you think is the best way to learn using WinEcon.

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.....

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.....

Section C : The Future

WinEcon and CAL packages like it could be used to teach and assess more of the modules future students take. Please indicate how you would like WinEcon and packages like it to be used in the future

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. WinEcon should replace the weekly lecture	12 (6.7%)	9 (5.0%)	64 (35.8%)	94 (52.5%)
2. WinEcon should replace the classroom tutorial	6 (3.4%)	27 (15.3%)	65 (36.7%)	79 (44.6%)
3. WinEcon should be fully integrated into the lecture and tutorial programme (with lecture notes and tutorial questions based around WinEcon)	37 (20.8%)	89 (50.0%)	41 (23.0%)	11 (6.2%)
4. There should be a lecturer present in every timetabled lab session	68 (38.0%)	91 (50.8%)	19 (10.6%)	1 (0.6%)
5. WinEcon should be abandoned altogether	17 (9.7%)	21 (12.0%)	89 (50.9%)	48 (27.4%)
6. WinEcon should be used for assessment (via multiple choice exams)	20 (11.4%)	69 (39.4%)	48 (27.4%)	38 (21.7%)
7. There should be an introductory session covering operation of WinEcon prior to the start of the course	56 (31.1%)	93 (51.7%)	25 (13.9%)	6 (3.3%)

Please add any comments you may have concerning the future use of WinEcon and packages like it

.....

.....

.....

.....

Thank You for Completing the Questionnaire

Paper 3

Clark, A. (2001) "What can we learn about computer-based learning from the Teaching and Learning Technology Programme's flagship product?"
Innovative Approaches to Learning & Teaching in Economics and Business Education. Ed: Peter Davies, SUP. ISBN 1 897898 82 7.

What Can We Learn About Computer-Based Learning from the Teaching and Learning Technology Programme's Flagship Product?

8

André Clark¹

Introduction and Background

WinEcon is a Computer Based Learning (CBL) package designed for use in the teaching of introductory economics in higher education. It is the flagship product of the Teaching and Learning Technology Programme's (TLTP) 'Economics Consortium', which is comprised of members of the Economics departments of 8 UK universities, with each being responsible for producing some of the 25 'tutorials' (chapters) of the finished product. WinEcon is provided within the UK for a nominal registration fee and available outside the UK at a commercial rate. Being the product of the official computer assisted learning programme within the UK and being the first and foremost of their outputs, WinEcon is for many students, including those doing business and combined studies as well as straight economics, the most significant experience of CBL encountered on entering University. There have been a number of reviews which describe the package's content, such as those provided by Crichton (1995) and Sloman (1995), but there has been little work on the learning experience it provides and no research was undertaken into this in the development of the product, although a survey of what is taught was.

In this chapter I report the findings of a three-year study into the first large-scale attempt to integrate this product into a teaching programme, (at the University of Glamorgan in Wales). I then attempt to explain the disappointing performance of WinEcon revealed in this study by reference to the assumptions about the nature of learning embedded within it. From this, I make some recommendations about what can be done to maximise student learning when using this product (and any other products that share the same assumption).

A Critical Appraisal of the Learning Experience Provided by WinEcon

It is the declared intention of the TLTP that WinEcon becomes integrated into teaching programmes and in that spirit the first large-scale integration of it, which was undertaken at the University of Glamorgan, was extensive and

thoroughly planned, with weekly WinEcon sessions and an original intention to use it for assessment too, although these plans were subsequently put on hold. The comments in this paper are based on the results of a questionnaire, of a total of almost 600 students who have been through this programme. The survey is taken at the end of their first year 'introductory economics' course and has been conducted over the past three years. The questionnaire and three sets of results are given as Appendix 8.1. The first year's results and a discussion of implementation issues can be found in Brooksbank *et al.* (1998) but are reproduced here for comparison with subsequent years.

The TLTP suggest that WinEcon can replace, rather than simply complement, staff-led seminars. As Crichton (1995) asserts "it is envisaged that WinEcon will replace seminars/tutorials". However, the experience at Glamorgan after 3 years of trying, is that this is unlikely. There never was much support for this amongst the student body and in the last two years the numbers supporting the idea - as indicated by the responses to questions 10 and 11 of the questionnaire - have fallen into single figures. In addition, the first year's results, reported in Brooksbank *et al.* (1998), showed that almost 90% of our students felt that a lecturer needed to be present when using WinEcon, which at the time we partly ascribed to our own lack of experience with it. But if this was in any way reflective of our inexperience with it then we would expect this to have decreased significantly since. It has, however, done nothing of the sort, with the second and third cohorts showing that 92% and 91% of students, respectively, felt the same need for a lecturer to be present. This means that, even if there had been a possibility of successful substitution of seminars by WinEcon sessions, it is unlikely that this would have resulted in any reduction in staff workloads. This suggests either that, if the fault is with us then there is nothing in WinEcon to highlight it so as to eliminate it, or more probably that there is a limitation in the type of learning WinEcon provides. This is not to say of course, that this is a one way street. We recognised from day one that teaching staff would have to adjust to WinEcon, since as Maddux (1994) argues, 'integration is the only option we have', it was beholden upon us in thinking "about the use of information technology in education ... to think about our pedagogy as a whole; the total art and practice of teaching needs to come under scrutiny" (Wild, 1994: 40-41). But that equally we are at liberty critically to consider the pedagogic assumption employed in WinEcon since as Bruner (1966) famously argued 'content cannot be divorced from pedagogy'.

The intention of the producers of WinEcon was clearly to create something in which learning was stimulated and they recognise the role of creating interaction to achieve this, since as they state, "some specific element of interaction on each page" is required to eliminate the possibility of producing simply a computerised book or "an electronic page turner," as the TLTP (1993 p. 3) refer to it, which is unlikely to generate much enthusiasm amongst a generation of students used to seeing things presented on computers. However, the responses to question 8 of the questionnaire indicate that the majority of students at Glamorgan do, indeed, see WinEcon as something of a computerised

book, with this opinion firming for the second and third cohorts to around two thirds. In fact, the numbers strongly disagreeing with the statement that it is more than a computerised book, doubled each year, to, in the final year, around a fifth of all respondents. In addition, answers to the open-ended question (question 14), most commonly referred to WinEcon's similarity and relative merits compared to a textbook, while the commonest suggestions for improvement concerned the need for more interaction.

The issue of interaction, in terms of both its type and extent, is therefore central to determining the nature of the learning experience of WinEcon, and looking at this provides us with a number of insights into how the makers of WinEcon see computer-based learning occurring. As for quantity, WinEcon clearly fails to live up to the requirement of the TLTP to provide some interaction on each page, since by simply working through it, I found that 60% of pages had no interactive content at all; consisting simply of a block of text. In addition, the type of interaction used in the remaining 40% is somewhat limited, since in over 40% of these the interaction consists of no more than answering a question, which on the whole could be answered incorrectly without much¹ interruption, or indeed any variation in the approach to learning on offer, other than a gentle admonishment and repetition. This strongly suggests that the designers assumed that nothing could be learned from the mistakes that learners make. In contrast, most economists are aware of certain differences between the way that they and their students think about this topic, since economists employ a range of implicit assumptions that, if not shared, may need to be addressed in a number of ways if everyone is to 'talk the same language'. This may even involve some reflections on the methods employed by the economist and the teaching approach they adopt, the possibility of which is ignored in WinEcon. Furthermore, 30% of the aforementioned 'interactive' pages entail the computer drawing a line or moving something, which is more of a demonstration than an interaction as such. On over 20% of the 'interactive' pages the interaction amounts to further blocks of text on either named examples, cases, or the opportunity to dig deeper using the 'More' or 'Advanced' options. About 3% of the 'interactive' pages contain further blocks of texts on key thinkers in the field, and a similar number have drag and point type interaction, (which equates to 1% of the total number of pages), but an equal number of pages have an apparent interaction that actually results in further blocks of text. Finally, although there are a few interactive simulation exercises, these are of the sort described by Moyse as involving "a list of control movements which would achieve operational goals" (Moyse, 1991: 25). The problem with these that Moyse identified and which has led to their decline in popularity, is that they can lead to students hunting for the right number, rather than learning about the content on which the simulation is based and this is certainly what seems to happen with WinEcon; with furious tapping at keyboards often in evidence.

This lack of genuine interactivity is, of course, both contrary to the stated intention of the TLTP, and, given that upwards of a million pounds was spent on producing WinEcon, a missed opportunity. In addition, even if we were to accept that there are some benefits to be had from putting an economics textbook onto a computer, (such as visual stimulation), since it is harder to read large blocks of text on a screen than on a page, computers are still “not best used to offer initial teaching, unless it can be expressed in few words and simple diagrams”: (Laurillard, 1993: 149). This is recognised within WinEcon, so that typically the number of words on each page is in the tens rather than in the hundreds. Indeed, it is testimony to the excellent editing and presentation of WinEcon that so many students felt that it explained difficult topics well. However, being provided with substantially fewer words than has previously been considered necessary to cover the topic at this level in a textbook must have some consequences. These I believe can be divided into three. Firstly, it results in relatively few real world examples and case studies being employed. Secondly, it results in short shrift being given to discussions about the topic as a subject and a lack of self referencing comments, so that the student may be left wondering why a particular topic within WinEcon is important, why it is being tackled in a particular way and how it relates to other topics. This is a problem since if students are effectively to control their learning they need to know how ideas link together, which topics are important and why, what learning (rather than just what topic) is a pre-requisite for what, and what the learning objectives are. Finally, hard decisions have had to be made about what to leave out, which effectively takes away some choice from the teacher and in parts has made the text insufficiently detailed for the best students. There are also problems resulting from the approach adopted to the practicalities of producing WinEcon. Since so many authors were involved and because they worked in relative isolation, there is some lack of uniformity in the text, with noticeable differences in the amount of interaction, degree of content difficulty and grammatical style in different sections.

Although the learning process cannot be individualised to the extent that the student determines what Plowman (1992) calls the ‘path of disclosure’ within such a package as WinEcon, the lack of interaction in WinEcon means that the only control the student has over their learning is to vary the speed at which they work through the text. That is not to say that this is not appreciated: the responses to question 7 of the questionnaire show that it clearly is. However, this cannot be taken as comparable to the level of control, of mutual re-adaptation, and tailoring to suit specific-needs that experienced teachers employ in the tutorial setting. For although WinEcon is referred to as a tutorial system, in the absence of that sort of control it doesn’t come across as such, which is why so many students in each cohort felt that it should not replace classroom tutorials, which at best involves using “the students’ performance on previous tasks to decide what tasks should be set next, without which it is not a tutorial” (Laurillard, 1993: 152). While purists would claim that there is still no such thing as human-computer interaction, there are, nonetheless, programs that create the illusion of it by responding to inputs in this way, and which are therefore often

approach since it directly tests how accurately information is known, rather than what is understood: (see Gow and Kember, 1993), which is to say it tests whether the message has been received or not. This is not to say, however, that the text, or the order in which the text must be dealt with is fixed: the authors of WinEcon recognise that no off-the-shelf computer-based learning package can be expected to suit all tastes, and there is a facility for the user to edit the text to suit their needs. Nevertheless, a more student-centred approach would have focused on what is understood and would typically be assessed using reports, case studies and problem-solving tasks, which cannot simply be added to, or squeezed within, the current WinEcon shell. Secondly, the feedback in WinEcon is of the 'no, because' type generally referred to as 'extrinsic' feedback. The problem with this type of feedback is that it fails to address conceptual misunderstandings, because it denies the possibility of a plurality of prior understandings, and thus a plurality of misunderstandings, and may by keeping them hidden, increase the possibility of finding them largely intact at the end of a course, (which as Dahlgren (1984) has observed can be a feature of economics courses). To deal effectively with these, some form of 'intrinsic' feedback is needed as well, as Laurillard (1993) argues. Intrinsic feedback arises as a product of the interaction with the conceptual model in question, to such an extent that the learning process becomes conditional upon the response to it. In contrast, what few simulations there are in WinEcon engage the student in some form of extrinsic feedback-guided search procedure, rather than entering them into some sort of dialogue with the underlying model. I conclude from this that the transmission approach has been employed in the construction of WinEcon. This is problematic insofar as the transmission approach ignores students *ex ante* understandings of topics and how they integrate the information through those understandings. This approach is also by its very nature indifferent to the approaches that students adopt to learning and it thereby effectively dismisses how they learn as a consideration.

Conclusions and Implications

If WinEcon had been designed to reflect what has been learnt about the way students learn, and was responsive to their current conceptions of the subject matter, it is likely to have been more successful as a stand-alone learning vehicle, for as (Laurillard, 1994: 187) argues "it is impossible for teaching to succeed if it does not address the current forms of students' understanding of a subject". Or to put it another way, unless it recognises the importance of "not only the nature of the knowledge itself, but also the nature of the knower and the knowledge-getting process" (Bruner, 1966: 72). An understanding of the significance of this would have enabled the consortium to engage in a dialogue with the learner and incorporate programmed responses to misconceptions, instead of which this must be done outside of the program parameters, so that a teacher inevitably needs to be present when WinEcon is being used. To incorporate all possible misconceptions in a computer program may seem to be an impossible task. However, these misconceptions are not random or

necessarily extensive since students deal with a relatively static body of knowledge at this level in economics, in a process that is replicated in many institutions, and within the same institution time after time. The result, gleaned from discussions of shared experience amongst teaching staff is that there are a few key, reoccurring misconceptions that are encountered in teaching introductory economics and failure to recognise these may help to explain why so many students felt that a teacher's presence was needed when using WinEcon and why heavy use was made of the teachers who did supervise the sessions. This is not to say, however, that packages like WinEcon cannot serve as complements to teachers' efforts. Indeed, the transmission approach has the advantage of a level of linearity in its monologue that can act as a corrective to any overly meandering teacher-student interactions. Moreover, there is a sense in which WinEcon can become more than merely an add-in to existing curricula if its facility for allowing differences in pace can be utilised, which is what we are currently working on at Glamorgan. I use the term 'working on' because as this research suggests, legitimising differences in pace has to be actively facilitated by the teacher, since simply expecting those who fall behind to resist the temptation of pressing the enter key to catch up is unrealistic. This individualisation of the process may be possible if WinEcon can be utilised in small enough groups to allow for it and if students can be convinced of two things. Firstly, differences in pace and comprehension are the norm and secondly, it is acceptable to revisit topics covered in WinEcon sessions, since there is no automatic expectation that everything covered in such sessions has necessarily been fully learnt.

Notwithstanding such on-going developments, this research suggests a role for WinEcon that is significantly less than was once anticipated. It is essential therefore to review both the limitations of this research and the implications of it for the future development of CBL in the UK. One criticism of this research that cuts some ice is that as a new University we have a predominance of Business Studies students studying introductory economics at Glamorgan, rather than Economics undergraduates. However, the amount of ice this cuts is small, since to argue that business studies are so poorly motivated towards economics relative to straight economics undergraduates is akin to arguing that only those who express the strongest prior preference for the subject can stand to use this product. Moreover to argue that it wasn't really designed for Business Studies students seems rather lazy at best, given that this is the largest group of people studying introductory economics in the UK today.

If the conclusion that WinEcon is intrinsically limited by the assumptions employed about CBL within it is valid, then it must also be concluded that this has a number of consequences beyond that of simple disappointment with such a worthy project, since the scale of this project is such that it may have crowded out other developments. Its opportunity cost can perhaps be gauged by comparing the situation in the UK with that in other countries: In many other countries, including the US, the approach seems to be dominated by small grants for small schemes by specialists driving their own projects, (although like

other academic outputs building on the work of others, of course). In contrast, the approach here was, and to a large extent still is, more centralised, with the TLTP playing a major role in delivering what were planned to be computer packages broad enough and deep enough to cover whole subject areas at a the HE level. It is not simply a case of a free-market approach versus a centrally-planned approach, there are other features of the UK approach which undermine its attempt to disseminate good learning. First and foremost is that the assumption within our approach, about how computer-based learning happens, seems largely absent in the US; not, I suspect from any intent, but simply from the diversity of the sources of CBL there, as well as the tendency for competition to eliminate poor products and the extensive beta-testing that each product becomes subject to as individual lecturers and teams try out their products on their captive end-users, (i.e. their students). This spirit of experimentation is largely absent in the UK in subjects which have large TLTP-provided packages. The reasons for this are likely to be twofold, firstly that being in competition with something as big as WinEcon acts as a deterrent, and secondly that it is hard to get funding for software development in these areas, since they are often considered to have been catered for. It might, of course, be argued that it matters little since we are set to benefit from developments outside the UK, but not all of these are offered free and few are targeted on the specific needs or interests of UK students.

If, as I suggest, some of the problems with WinEcon can be laid at the door of widely held assumptions about the nature of learning, then it may be possible to generalise some of the conclusions of this research. Firstly, if the argument presented in this paper is correct and understanding the assumptions about how learning is assumed to occur within a package determines the way in which it can best be employed, then further research of this sort is essential to the future development of CBL. Secondly, if the assumption that learning occurs by transmission is employed, then the onus on good teaching is in no way reduced by the introduction of such packages. Thirdly, it may always be necessary to spend time thinking about, and talking to students about, the ways in which a particular CBL package is expected to contribute to their learning, since the assumptions employed within it will alter what needs to be said. Finally, this research suggests that those who thought the production of CBL packages of this size and scope would allow for significant substitution of resources were mistaken, since the maximisation of individual learning from packages like WinEcon militates against any reduction in teaching inputs and any increase in group sizes.

Note

1. The usual disclaimer applies and readers should note that the views expressed are those of the author and not of the University of Glamorgan.

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Appendix 8.1 Questionnaire Results (For Cohorts 96/97, 97/98, 98/99)

	Strongly agree			Agree			Disagree			Strongly Disagree		
1) I enjoyed using the WinEcon package	3%	8%	5%	54%	44%	40%	36%	40%	46%	7%	8%	9%
2) WinEcon was interactive enough to keep me interested	2%	9%	4%	53%	36%	36%	40%	45%	50%	6%	17%	10%
3) WinEcon was easy to use	25%	15%	16%	73%	59%	70%	2%	22%	12%	0%	5%	2%
4) WinEcon complemented /added value to the lecture notes	10%	3%	4%	50%	42%	46%	39%	47%	46%	6%	9%	4%
5) WinEcon complemented /added value to the tutorials	9%	0%	2%	50%	48%	44%	39%	44%	46%	6%	6%	10%
6) WinEcon explained difficult topics well	6%	1%	0%	52%	36%	40%	38%	45%	52%	5%	18%	8%
7) WinEcon gave me flexibility to learn outside normal classroom hours	18%	20%	12%	69%	50%	54%	12%	29%	29%	2%	2%	5%
8) WinEcon is more than a computerised workbook	3%	2%	1%	43%	28%	32%	48%	57%	46%	5%	12%	20%
9) I needed to take notes when using WinEcon to get the most out of it	19%	11%	23%	56%	54%	54%	22%	30%	19%	3%	5%	5%
10) WinEcon should replace the weekly lecture	7%	0%	0%	5%	2%	3%	36%	38%	39%	53%	60%	58%
11) WinEcon should replace the classroom tutorial	3%	0%	5%	15%	5%	4%	37%	32%	20%	45%	62%	73%
12) There should be a lecturer present in every timetabled lab session	38%	51%	28%	51%	41%	63%	11%	3%	5%	1%	5%	5%
13) WinEcon should be abandoned altogether	10%	27%	9%	12%	4%	24%	51%	35%	68%	27%	13%	19%

Note: In addition, there was an open-ended question:

14) Please state below your overall impressions of WinEcon. How could WinEcon be changed to make it more useful?

Paper 4

Clark, A. (2003) "Methodological individualism, cognitive homogeneity and environmental determinism". *Journal of Economic Methodology*, 10(1): 79-85.

Methodological individualism, cognitive homogeneity and environmental determinism

André Clark

Abstract A study encompassing a number of UK Universities identified a widespread implicit environmental determinism employed in the teaching of Economics to business studies undergraduates. In this paper the author argues that this bias is an inevitable by-product of the methodological individualism adopted within mainstream economics. The author concludes that methodological individualism is, therefore, flawed both as a mechanism for accessing the reality of the business world and the power of firms within it, and for teaching others about that reality, particularly as it also acts to undermine student motivation.

Keywords: methodological individualism, environmental determinism, power

1 INTRODUCTION

Reflecting on the methodology of mainstream economics was not the original purpose of this research, indeed the author – like many of his business school colleagues – had learnt to ignore methodological issues, and would have continued to do so if it had not been for the consequences of that neglect on student motivation. The link to methodology first became discernible following an investigation encompassing seven universities in the UK into why so many business studies undergraduates were reported to find introductory microeconomics both difficult and uninspiring. This was confirmed by further questionnaires and discussions (see appendix A) at one of these – Glamorgan in Wales – where it led to the introduction of a new approach based on an explicitly non-determinist and non-methodological individualist approach. (See appendix B for a brief discussion of the practical differences between the traditional and new approaches.)

2 THE PROBLEM

The results of the initial work into what students found difficult or demotivating about economics confirmed what staff already knew about

the bulk of business studies undergraduates: that they do not like maths and often find graphical analysis confusing rather than enlightening, and so on and so forth. However, in addition to these well-known obstacles to learning, it was possible to discern another less obvious one, that I think can best be described as an element of assumed environmental determinism', which was common to all the teaching, and by implication, all the lecturers – including myself – in the study. Initially, it was unclear what the problem was in respect of this, since the students' concerns were not articulated in methodological terms. Hardly surprising of course, since they were never supplied with the methodological language to do this, and were never made aware that this could be an issue in this subject. Nonetheless, their comments spoke of a common perception amongst them that in the eyes of the economist firms' decision-makers are essentially passive in respect of environmental contingencies. The problem is that this does not tally with the role decision-makers (and by implication therefore, the students themselves in their future personifications), are given in other subjects, particularly those like marketing and strategy in which the emphasis is on the ability of managers to create their worlds.

That students were picking up the message that in economics, 'the decision-maker's freedom of choice is spurious' (Latsis 1972: 210) reflected the fact that regardless of a widespread disinterest in methodological issues, observed regularities in practice confirmed that a methodological individualist approach was widely adopted. It was not, however, as unobjectionable as the leading introductory economics textbook would have it, suggesting merely that we should base our theories on 'average or systematic behaviour' (Begg 2000: 27), since staff seemed also to follow Marshall in believing that 'the struggle for survival tends to make those methods of organisation prevail, which are best fitted to thrive in their environment' (Marshall 1956 [1890]: 495).

What happens, therefore, is that the assumption that our explanation of events begins with the individual, collides with this Darwinism to ensure that variety stems only from differences in situational imperatives, since the rational (solution consistent) response is assumed, ultimately, to win. Hence we get student comments like, 'With marketing firms get to do things, in economics they don't', 'In economics everything is set by market structure so why can't we have a clearer list of what it says?', 'Economics is about the world outside the firm, strategy is about what to do ... to change that (world)'. The fact that such views are widespread is supported by the fact that the majority agreed with the statement in the questionnaire that, 'Economics teaches us that firms must accept the dictates of the business environment (the market structure it is in and so forth) or else!' Clearly, then, an element of environmental determinism was being taught, even if only implicitly, and it is clear that this is something the students have learnt about economics – rather than something that they

intrinsically believe to be true about the world – since 90 per cent disagreed with the suggestion when marketing rather than economics was used in the question. This contrasts with the view held after the introduction of the new, specifically non-determinist, non-methodological individualist course in which the majority rejected this notion, or displayed an ambiguity towards it (which subsequent questioning revealed indicates not so much a lack of opinion as the feeling that it does indeed dictate the outcome in *some* situations, which is of course unobjectionable).

3 THE LINK BETWEEN DETERMINISM AND METHODOLOGICAL INDIVIDUALISM

The ‘collision’ of determinism and methodological individualism might be taken as a mere coincidence, and it is of course unquestionably true that one can be a determinist without adopting methodological individualism, it is nonetheless my contention that the two are inextricably related. Indeed, it is my contention that methodological individualism has an intrinsic deterministic bias of sufficient magnitude to scupper any attempt to remove determinism without removing it too.

It is at this stage very important to clarify what the accusation is here: it is common, for example, for the straw-man economist who takes agents’ values as immutable and fixed so that their behaviour is entirely determined by external factors, to be labelled as an ‘economic determinist’. However, the criticism here is not that this kind of ‘single-exit’ theorizing dominates, but that the exits are determined independently of the actors since the methodology employed forces us to see the environment as existing objectively and independently of how it is perceived or who perceives it, or put most simply, that it separates objects and subjects. This separation certainly has advantages, for example, it allows us to parachute homogenous subjects into heterogenous environments to see what happens; profit-maximizing businesses, for example, into different market structures. This is a neat simplification and might even be considered tantamount to allowing for various responses if we vary the behavioural assumptions of the firm. This does not, however, amount to the same thing at all. It is not simply that the method by separating parts

Table 1 ‘Economics teaches us that firms must accept the dictates of the business environment (the market structure it is in and so forth) or else!’

Approach	Strongly disagree	Disagree	Don't know	Agree	Strongly agree
Traditional	2%	13%	26%	43%	15%
New	11%	40%	34%	10%	4%

from the whole *permits* a 'Darwinian' assertion of the primacy of the whole over the part, it is that what it is separating *inevitably* does. Although determinism and individualism are often put at opposite ends of a spectrum, in this case methodological individualism begets environmental determinism, since the reduction to psychological traits that are not culturally specific, learned, or socialized, imposes an *a priori* decontextualization that makes it inevitable that when context is re-introduced into a scenario, events become largely driven by it. Since the method exogenizes context, how the hegemony of the environment is then dressed up is secondary, or indeed something of a red herring, since with or without any appeal to Darwinian ideas determinism emerges. While rejecting determinism may, therefore, affect the evolutionary or biological analogies that we employ, what it forces us to actually abandon is an uncritical acceptance of the neutrality of methodological individualism because once we separate subjective processes from external objects, the belief that explanations for the variations that make up the patterns of the world tend to be sought in variations in the latter rather than the former. This amounts, however, to assuming a degree of cognitive uniformity and separability in subjects that is more consistent with a nineteenth century conception of mind than a twenty-first century one.

This methodological trait does not have to be consciously recalled by the teacher to feed a deterministic bias since it is ingrained in the language that separates individuals from contexts, such as individual rationality (and less obviously market forces), as well as in the language of taken-for-granted 'common sense' interpretations of why firms have to follow some specific paths given some environmental change 'leading to', or being 'brought about' by, or 'inevitably meaning that' or 'requiring' some change in price, output or whatever. In this manner, variable responses to mono-causal external causes may ultimately be pigeonholed into those that were rational and those that were not. The end result in the classroom is that the sort of free choice, which would in Austin's (1961) terms, mean not just that firms' decision-makers could rationally act differently given different antecedents but could do so given the same antecedents, is denied. This would not strike many economists as an extreme position, and to many it might seem preferable to falling into the opposite trap of assuming away any determinism and returning to a pre-Descartian view of the world (or entering a post-modern one). In this 'vague and indifferent state in which no necessary factors ... can be admitted to exist' (Williams 1981: 101–2), all firms would face an infinite range of equi-rational paths in response to any given contingency, all views would be equally rational, the boundaries of rationality would become indefinable, and the whole crux of the matter would shift to one of learning and cognition, with microeconomics becoming merely a subset of somebody else's subject.

If this was the alternative then perhaps we should leave well alone, particularly as the issue is merely one of bias, the extent of which is a complete guess given that we do not know ex-ante whether it is true for any given case or not. However, this is no reason why we need to go to the opposite case, since the alternative to any assumed determinism is not to assume its complete absence but to recognise a range of possibilities. My argument is simply that in the absence of empirical evidence I have found what seems to be a resort to a methodological pre-supposition that introduces an element of systematic failure to conceptualize the scope for some different interpretations to be equally valid. It entails, therefore, a fundamental misinterpretation of the nature of the strategic choices facing firms (both big and small), which is unempowering for business undergraduates insofar as it heralds a reactive and circumscribed future for them.

4 POWER

Since the aforementioned 'separation' within methodological individualism downplays the significance of cognitive differences, outcomes tend to be interpreted as independent of any such differences so that different people in the same context with the same resources tend to be assumed to have the same power to change their environment. This creates the impression that power is measurable by objective external factors and, as a matter of convenience, this means that power within economics (and not just in teaching) becomes synonymous with what is most easily measured, such as the number of competitors. Rejecting this shallow conception of power means rejecting the methodological individualist approach, since a deeper conception of power requires that we take proper account of its subjectivity. In particular, since power can be exerted discontinuously in the objective sphere and remain continuous in the subjective sphere, as Foucault (1977) argues, it is rendered in part completely invisible to those who adopt the methodological individualist approach. This is not to say that economists are unaware of broader issues than market structure and the like, but that even when broader political issues are coming into view their treatment evidences the same blind-spot, with a focus almost exclusively on those things which have not yet become a part of the disciplinary rules that govern economic activity and which are not, therefore, mainly in the mind (so to speak), rather than in the news. A narrow view of the powers which firms have is thereby created, and an unwarranted emphasis on limited types of action becomes routine in the classroom. Rejecting methodological individualism inevitably therefore facilitates the broadening of our conception of power to encompass the ability to impose definitions on situations, and set the language in which they are discussed. As a practical matter, what this means is that one of the defining differences between the old and new approaches that we have adopted in

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the classroom is that the reinterpretation of economic dialogues and reflections upon the methodological assumptions of those who interpreted the events in question becomes central to the case studies that are the main vehicle for facilitating such dialogue.

5 CONCLUSION

The contention of this paper is that methodological individualism inevitably leads to an element of environmental determinism, which is misplaced and has negative implications for teaching economics, particularly with regard to business studies.

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APPENDIX A

Survey questions

The options for all questions were of the Likert scale type: Strongly disagree / Disagree / Don't know / Agree / Strongly agree, unless otherwise stated.

- Economics teaches us that firms must accept the dictates of the business environment (the market structure it is in and so forth) or else!
- Marketing teaches us that firms must accept the dictates of the business environment or else!
- Economics is useful in management jobs of all sorts and in running a business.
- Economics underpins other subjects such as strategy, marketing, and HRM.
- I found economics difficult.
- I would describe my motivation towards this module as low / medium / high.
- I would describe my motivation towards the rest of my studies as low / medium / high

- I am easily bored.
- I understand why we do what we do in this module.
- I like to go beyond what is required to pass a course in order to investigate the meanings and connections between the ideas presented to me.
- I had no particular problems outside of the module that affected my performance.
- What factors are important in determining your enjoyment or motivation towards this module? (open-ended question).

In addition there were questions on the pace and standard of teaching, resources, age, sex, and mode of study as well as a number of questions covering career ambitions and so forth which were not considered relevant to the topic of this paper.

APPENDIX B: TEACHING ISSUES

Pedagogy

Although it is intrinsic to the changes made that allowance is made for a greater discussion of method and an acknowledgement of its role, together with an increased openness to other approaches, substantively the main difference concerns the recognition of how differences in the environment might, reflect heterogeneity in people and how they respond to different situations. One offshoot of this is that an international approach becomes easier as these differences are most starkly illustrated by looking at people from other cultures. Generally, the whole emphasis shifts, therefore, from states of the world to states of mind and how power is employed to enact those differences. One major practical difference thus engendered is that case studies are used more often, but more importantly in a different way (particularly as there is no explicit intention of adopting a 'specific to general' approach): In the earlier research, case studies were typically chosen by lecturers to illustrate a point. In contrast, in the new approach they are used to discuss an issue from a number of perspectives, being repeatedly revisited to highlight the importance of how they are perceived, reported, acted upon, and subsequently interpreted.

Motivation

The point of these changes was that determinism (not methodological individualism *per se*) was empirically unjustified and demotivating. That this is a significant factor is supported by the fact that abandoning environmental determinism resulted in considerable improvements in motivation rates, with those putting their motivation as 'low' falling from 28 per cent to 12 per cent, and those describing it as 'high' rising from 14 per cent to 34 per cent. However, although I think of the new approach in terms of the rejection of reduction to given psychological states and of the prominence of choice over circumstance, it is equally true to say that it's more cases study based, more specific to general, and more problem-based. It is impossible, therefore, to identify the rejection of determinism and MI as the only factors in this improvement. Such identification is not, however, the main issue addressed in this paper, but the link to motivation is important since it is only in pursuit of this that many teachers would consider abandoning determinism if it entails such a large scale methodological rethink.



An experiment in teaching invention

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Abstract

Purpose – The purpose of this paper is to demonstrate that invention can be taught to business students who do not have the prior technical knowledge that is assumed to be a requirement for this kind of activity.

Design/methodology/approach – This paper contains reflections on the results of introducing a specific course in inventing based on the insights of leading figures in the economics heterodoxy, who reject key tenets of the standard-economics approach that treats invention as exogenous.

Findings – The result of this experiment suggests that teaching invention to business students is possible based on such foundations, as measured by the number of patent application made and granted.

Research limitations/implications – Since there is no widely accepted theory to explain invention, there is no control for this experiment. This theoretical limitation should not detract, however, from the evidence presented here that there is something of practical use in the heterodox tradition that is being overlooked in enterprise and business education.

Practical implications – This paper provides one model for teaching an important aspect of enterprising behaviour and also has practical outcomes in terms of the invented items themselves. In addition, it serves to demystify an aspect of business activity that is often left unexplored in business studies curricula.

Originality/value – The paper is innovative at a conceptual and a practical level in providing both a foundation for the study of invention based on economic theory, and advice on how this can be taught to achieve practical and independently validated outcomes.

Keywords Teaching, Innovation, Economics

Paper type Case study

Introduction

The Massachusetts Institute of Technology (MIT) encapsulates all that might be expected of a hive of invention; a technological tradition that they are justly proud of; easy access to cutting-edge technologies, and technologically minded students attracted from all over the USA. They also have a specific course aimed at getting their students to invent. By way of contrast, the University of Glamorgan, in Wales, largely attracts people from the local area, has almost no tradition in inventing or the commercial application of new ideas, and is not primarily a technological university. Nonetheless, at Glamorgan, a course was developed with the specific intention of getting students of enterprise, and business, to invent, which given this context was bound to be something of an experiment. The course was developed partly in response to increasing pressure from authorities keen to develop a more enterprising culture in Wales, and partly from an increase in the number of students who see starting their own business as an employment option (Hynes, 1996).



Can invention be taught?

The starting point for this experiment was the belief that more aspects of enterprise can be taught within a business school than currently are, since in UK business schools “only rarely, it would seem, is the focus on developing in students the skills, attributes and behaviour of the successful entrepreneur” (Kirby, 2004, p. 11). Deciding what to do about this is not easy, however, as there is little agreement amongst teachers of enterprise in the UK regarding what it is and how it should be taught, or even whether it can be (Bennett, 2006). Hardly surprising perhaps, as the subject suffers from:

[...] limited development of useful theoretical frameworks, an absence of rigour in much of the available research, and an inability to draw generalisations from the empirical work that has been conducted so far (Morris *et al.*, 2001, p. 36).

As a result, what students tend to get is either some practical business skills, or some attempt to develop within them some useful attributes or attitudes (Garavan and O’Cinneide, 1994). In light of this, some attempt was made on the course at Glamorgan to target both, with practical skills, in this case regarding how to identify and defend intellectual property, running alongside attempts to encourage the kind of creativity that gives rise to it in the first place. It was hoped this would give students the wherewithal to both create and to develop their creations along commercial lines.

Given that the literature strongly supports the idea that both the ability to innovate (Gibb, 1987; Llewellyn and Wilson, 2003) and be creative (Henderson and Robertson, 1999; Formica, 2002; Walton, 2003) are key facets of enterprise, inventing would seem to be a good candidate for what should be taught on an enterprise course. It very rarely is, however. This is probably because it is assumed that prior knowledge of a technical nature, that business students are unlikely to possess or be receptive to, is a pre-requisite to invention. Indeed, it is undeniable that it often is, and it can even be the case that prior technical knowledge is required just to identify that an opportunity for developing a product exists at all (Shepherd and DeTienne, 2005). However, an increasing number of patent offices around the world are agreeing to patent conceptualisations and software rather than tangible engineered artefacts. For example, the vague assertion that a glass can “automatically” test for illicit drugs contained within it, with no indication of how this might actually be done, formed a patent application that was cited as something that could have stopped the author’s patent, GB2447899, from progressing. Couple this with the growing ease with which ideas can be visualised and made real using CAD/CAM and you have, nowadays, what amounts to an unprecedented opportunity for those whose expertise is focused not on how technology works internally, as might be understood by students of engineering and science, but rather on how it works externally in the market place; what need it fulfils, how it relates to existing substitutes and complements, and so on, as might best be understood by students of business and enterprise.

On the other hand, Slocum (2001), who is heavily involved in encouraging inventiveness at MIT, says on the MIT web site that, “it is impossible to ‘teach’ someone to invent”. However, this comment is tempered by the fact that he goes on to say that:

[...] all I can do is preload them with deep, insightful, fundamental principles, help them to realize their passion, and help them learn to identify others’ passions. Thus, wired, their bionural nets take over, and POOF they start to invent.

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This is more positive for the experiment at Glamorgan, but it puts the emphasis on facilitation only, and the principles that Slocum refers to are, of course, engineering ones that cannot be provided on a business studies course. Nevertheless, this offers a glimmer of hope if the fundamentals of the inventing process itself can be identified and taught, and if ways of encouraging “bioneural nets” to be creative can be systematically developed. In fact, some of the fundamentals of the inventing process are easily taught, because once students get used to the strange vocabulary differentiating between what is covered by any given intellectual property claim and what is not is relatively straightforward, since all patent applications follow a standard format. This uniformity also allows students to learn how to write such applications themselves. On the second aspect of this experiment – the issue of creativity, there are also grounds for optimism, since “entrepreneurship” is now a core subject within most business schools, including Glamorgan, we might expect that by the time students reach this final year course they would have developed some of the creative skills that would enable them to begin to invent once allied with the aforementioned procedural knowledge. The issue of “what, though, is being taught?” (Klein and Bullock, 2006, p. 431) soon arose on the course, however, since students appeared genuinely surprised to be asked to be creative in anything other than presentational terms. Not surprising perhaps as the “content of most entrepreneurship curricula seems far removed from the concerns of Schumpeter, Knight, Kirzner, or Schultz” (Klein and Bullock, 2006). These being authors most intimately associated with the idea of entrepreneurship as creativity. This oversight is attributable to the fact that such authors are members of the heterodox tradition in economics that stands in opposition to the neoclassical orthodoxy, which dominates microeconomic teaching in the UK – and elsewhere – to such an extent that few students would even have heard of these authors. Ignoring this alternative would, however, have been an unacceptable omission on this course since the neoclassical method is unable to treat creative activities, like enterprise and invention, endogenously (Clark, 2003).

Course content

Although the practicalities of writing patents provides a solid and straightforward starting point for this course, the issue of how to create the spark of inventiveness has to be addressed sooner or later. In introducing this, the author took as a starting point the need to acknowledge that enterprise is a response to what we do not know rather than what we do. Knight (1921) was one of the first to recognise this, developing a theory of enterprise based on uncertainty rather than risk, where risk is defined as a random process with a knowable distribution of outcomes and uncertainty a random process with an unknowable distribution of outcomes. For neoclassical economists, risk is more interesting as it can be modelled mathematically. For Knight, uncertainty was more interesting – despite its mathematical intractability – as it is a more accurate depiction of the reality that gives rise to enterprise. With uncertainty it is “impossible to classify instances objectively” (Knight, 1921, p. 259) and cannot, therefore, rely on “reasoned knowledge, but ‘judgment,’ ‘common sense,’ or ‘intuition’” (Knight, 1921, p. 211), which is why we have entrepreneurs and inventors, rather than the arbitragers and coordinators that dominate the neoclassical economics literature. The implication of this for a course in invention is that since there are far more opportunities than can be imagined, students’ ability to imagine them may be influenced by the way they

approach categorising developments, since new classifications imply an inventive step. In light of this, considerable time was spent on the course encouraging students to develop and trust their own ability to create new categorisations, even if no immediate commercial application could be found for them. To illustrate both the power of categorisations and the inertia they create in the mind, the example popularised by de Bono (1985) was used. This is where the categorisation of wheels as round inhibited the development of active suspension, which is ideal for square ones, (but which can also be usefully applied to round ones traversing bumpy ground). Encouraging this kind of re-categorisation sounds fairly straightforward, but in fact necessitates a considerable effort since business schools do not routinely create the kind of learning environment in which such creativity is directly and unambiguously rewarded.

Rewarding creativity

Although the gap between a good idea and a marketable product is shrinking fast, it still takes years rather than months even to lay claim to an invention, let alone make any money from it. Invention alone does not, therefore, provide sufficient motivation for the typical student given the effort required to do it. This was felt to be a particular problem on an untried and untested course, as no guarantees of any kind could be given. The second motivational problem stems from the fact that being creative is a risk in itself, as there is an ever-present "risk of ridicule, of rejection, or of severe resistance to a new idea" (Smith, 1991, p. 271). Encouraging creativity, therefore, necessitated developing a strategy to overcome this, and since assessment is one of the main barriers to students taking such risks (Berenson and Carter, 1995), it was decided from the outset that the assessment reward on the course would be based directly on whether something had, in fact, been invented. Although there are usually no specific guidelines for judging creativity (Sobel and Rothenberg, 1980), in the case of invention we have something more concrete, there being an official patent-office procedure that determines whether something qualifies as an invention or not. To qualify an idea has to have a potential commercial application, must not be an obvious step from an existing idea, and cannot simply be a combination of two (or more) existing inventions – as confirmed by databases of existing patents. This means that although assessing students on the course could not be based on whether an idea actually passes the official test, because it takes too long, we can nevertheless apply exactly the same tests using the same databases as the patent office to mark students' efforts within the framework of a one-year course. In addition, since students are often unaware of teachers' expectations (Hutchinson and Beadle, 1992), it was decided from the start to be explicit about what was expected in respect of this. This entailed showing all students how to access said databases, and explaining how these would be used to judge their work. That, in practice, the author's judgements on this was similar to that of UK patent office is confirmed by the number of ideas generated on the course that have subsequently gone on to be successfully tested by UK patent office, and in one case different patent offices around the world. (For example, patent numbers CN1977523 and SG136132 are for the Canadian and Chinese versions of an original UK application relating to software for mobile phones.)

To further encourage creativity on the course, the author patented his own ideas and tried, as far as possible, to reveal to students the creative thought processes behind them. This, it was felt, would raise the credibility of the teaching too, since teaching is

most effective when personal experiences can be introduced (Shaughnessy, 1991; Morganett, 1991, 1995). It was also decided that motivation could be increased if some tradition for invention could be established amongst the student body as well. To this end, one student idea was developed in the first year of this experiment to act as a beacon for subsequent students to follow, and in due course the – award winning – company that resulted from this (Company Number 5187678), became a university “spinout”. This was used as evidence that there was, indeed, something that could be learnt on the course. Also, since students are likely to be more active in the learning process when they can relate it to their personal experiences (Wilson *et al.*, 1974), those involved in developing this spinout were invited to talk to subsequent student cohorts about their experiences. These talks entailed two types of discussion: first, regarding the inspiration for the idea; and second, about the trials and tribulations entailed in getting the product to market. In other words, both the invention and the innovation aspects – to use Schumpeter’s (1939) distinction. It was hoped that this dialogue would also serve as something of an antidote to the idea prevalent amongst students that inventors had to be of a certain age, or maturity, or personality type. It was not entirely successful in this regard, however, for although the majority of students accepted the premise of the course – that anyone could do it – nonetheless there was always a few who doggedly refused to accept the possibility that invention could be learnt to any useful degree. Little wonder perhaps when the main theories suggest that the inventors’ club is a hard club to join: The “great man” theories, by focusing on the prolific genius of some historical figures make this club look very exclusive, while trait theories suggest that although you may not have to be a genius as such, you must at least be the right type to join. Neither approach seems likely to allow a business studies student to think that they might acquire such a talent, especially when the view that there is something different in the way innovators are hardwired is still being actively promoted. Indeed, McGrath and MacMillan (2000) produced a whole book promoting the idea that only some individuals have an “entrepreneurial mindset” that enables them to find opportunities that everyone else overlooks. Even worse, in many interpretations, invention is seen as coming out of the blue, in what economists refer to as “autonomous” invention and everyone else calls “eureka” moments. This may, of course, be how, looking back, some inventors describe what they do, but if students see creativity in terms of inexplicable “eureka” moments they are unlikely to be receptive to the idea that it can be taught (Wright, 1990). Fortunately, there is an alternative literature that emphasises that creativity, at least, can be learnt (Torrance and Myers, 1970; Woolfolk and McCune-Nicolich, 1980), and an offshoot of this is a literature that emphasises how creativity can be taught in a business context. This ranges from the corny self-help, get-rich-quick type, to extensively researched guides for learning to think “outside of the box”. These are not widely accepted, however, and only occasionally mentioned in teaching at Glamorgan. In practice, this meant that convincing students of the possibility of learning to invent has to be addressed early in the course, and had to include both a positive element and a negative element of debunking of the “great man” and “trait” approaches. In this respect, the great inventor Thomas Edison is a gift, since he described inventing in “eureka” terms, but in practice treated inventing as normal business; using an assembly line approach in which staff were expected to invent, and duly did.

Having addressed the issues of motivation and produced a convincing case to support the possibility that it might happen on the course, the next step was to design some classroom activities to try and actually make it happen, since as one student pointedly bemoaned, despite enrolling on an enterprise degree, it "hadn't happened yet". In the four year period in which the course was run at Glamorgan, it was found that what worked best in generating the initial spark of an idea was first "alertness" exercises, that we shall look at later in this paper, and what amounts to a kind of "creativity transfer", which entails taking a creative strength in one area and using it in another. For example, the skill that all students seem to possess in making things up on the spur of the moment can be utilised by, for example, pairing abstract words and getting students to justify and sell whatever the words happen to say as if it were a new product. In so doing students' creativity can be tapped, and bent to the purpose of inventing products and services. A prerequisite of this is that the risk of possible embarrassment that this entails is reduced by the insistence that ideas are never criticised other than in terms of practicalities, because when teachers are "respectful of unusual questions, respectful of imaginative and unusual ideas" creativity is encouraged (Torrance and Myers, 1970, p. 253), and if ridicule becomes part of the interaction confidence can be rapidly undermined (Morganett, 1991). To help with this, examples of famous entrepreneurs' less successful and – not to put too fine a point on it – occasionally daft ideas were occasionally thrown into the teaching mix.

This is not to say that students can be entirely shielded from disappointment on such a course, since even if initial investigations suggest an idea is original it may not be as there are lags in the patenting system. In fact, since all ideas are protected from a date that is prior to the public notification of that protection, people can be working on an idea for some months in blissful ignorance of the fact that they have no legal claim to that idea. In addition, even when the rest of the world is told, it may not be clear what the idea actually is, as titles and even abstracts can be vague, cryptic, or poorly translated. Discovering that some other inventor got their first is inevitably a disappointment and when it happened to students on the course it was found to lead to both denial and annoyance, neither of which is very constructive in achieving the stated aim of the course. Consequently, an approach was developed specifically aimed at rescuing something from such a situation by looking for an alternative application to all, or part, of an idea. A number of options were experimented with, but most – inevitably – involved loosing some elements from the original idea, often resulting in the filing of a patent application for a small, overlooked, part of someone else's bigger idea. For example, GB2432753 fills in a small gap that fell between the patents filed by a number of leading technology firms. Building on other people's ideas in this way is, of course, something that students are familiar with from writing assignments in which they synthesise their own ideas from the work of others.

To complement this, a way of looking for gaps in the inventing landscape was developed based on the idea that effective entrepreneurs are "those who are adept at recognising patterns or forces that combine to form opportunities" (Morris *et al.*, 2001, p. 41). Combining this with the approach to categorisation previously mentioned, a classification was built upon: feel (bigness, boldness and brashness); toughness issues (reliability, responsiveness and robustness), extras (add-ons, advertising and appeal); the degree of initial interest amongst consumers and investors (impact, indulgence and interest); style issues (niceness/fun, novelty and nuance); use of resources

(efficiency – cost economies, ease of use – time economies and environment – resource economies) and performance issues, (speed, slowness and smallness). As this developed the term BRAINERS, analysis was applied (despite there being only one set of *r*'s in it), since by using several such matrices, with one placed below the next for each significant development of the product, patterns were revealed that had some value in analysing where the next inventive steps might lie. In some cases, it was found that products exhibited linear trends, reflecting a concentration within one particular dimension, while others exhibited more switching, which may reflect changes in what is technologically feasible, or simply changes in what people want. From these patterns, a broad inventing strategy could be inferred. For example, in looking at devices developed to detect drink “spiking”, it was found that the focus was on ease of use. To some minds, this suggests that the way forward was to invent something even easier to use. For others it suggests the exact opposite; that this is a product ripe for development in other dimensions. As a result both approaches were tried, with GB0718149.8 aimed at making it more fun, and GB0721894.4 based on ease of use. Since the latter is published it can be described a little more fully here as a drink receptacle that automatically tests for the presence of drugs in the drink by having a test device embedded in the structure of the glass, which cannot be tampered with and which provides a continuous test as the drink is drunk (by means of a tilt valve).

Another approach that proved fruitful, and which was also based on the work of one of the heterodox economists mentioned above, entailed encouraging students’ “alertness”. The ability to spot opportunities is now widely recognised as a key feature of entrepreneurship, and many authors have sought to show where it comes from, but Kirzner (1973, p. 31), provided one of the earliest and most comprehensive discussions of this “alertness to hitherto undiscovered opportunities”, or “the ‘knowledge’ of where to find market data” (Kirzner, 1973, p. 67, 1998). By this, he meant not what we refer to today as the facts and figures about a market; the statistics and other “substantive market information” (Kirzner, 1973), but, rather, the specific data that would evidence some gap between what we have and what we might want, or in other words what needs to be invented. As Kirzner (1997) put it in an interview:

We have to recognize that when the entrepreneur discovers the automobile, he is not simply disrupting the calm. He is identifying what was in fact waiting to be introduced. Technological knowledge was being misapplied. Resources were being wasted on trains, carriages, and bicycles, when, in fact, what was waiting to be put together was this new gadget called the automobile. A person who recognizes this is responding to a pre-existing, gaping hole in the market.

Unfortunately, for what we are considering here, Kirzner does not provide many clues on how alertness to such gaps is achieved; he refers to “spontaneous” learning (Kirzner, 1979, p. 146), and he suggests that if the rewards to it are increased we will get more of it (Kirzner, 1979, p. 149), but little of direct applicability. However, others building on his ideas provide more clues; Fu-Lai Yu (2001, p. 57) for example, argues that it entails “taking a fresh, clean look at old knowledge”, which needs to be divorced from urgency and problem solving since “the most striking quality of entrepreneurship [...] is that a true entrepreneur does not need problems to enhance alertness” (Fu-Lai Yu, 2001, p. 58). As a result, rather than focus on problem solving techniques (such as TRIZ) in this experiment, students were encouraged to agree a set time in the day when they would simply reflect on whatever they happened to be doing at that time, (the idea of

encouraging a permanent state of alertness having been rejected as expecting too much). In particular, students were asked to reflect on what they were doing in terms of their main senses (such as vision, touch and smell), and make a list of what would enhance the experience if it was a pleasurable one, or reduce it if it was not. Although it is difficult to quantify the number of ideas coming from different exercises, some can undoubtedly be traced back to this kind of activity. For example, one student's personal bath-related "eureka" moment came from his reflections on the way his knees and shoulders got colder as the rest of him got warmer while taking a bath, as he was unable to simultaneously get both under the waterline given the relatively low position of overflow pipes in British baths. His solution (GB0819753.5) was an attachable overflow extender of unique design that allows the bather to get more water into a bath before the overflow is activated.

Results

A simple test of the success of the course within the stated aim of increasing invention, is to note that while no inventions – or even patent applications – were recorded in association with this course prior to the changes outlined here, more than 40 formal applications have been made in the four years since the experiment began (from a total of 122 students, having attended the course). Of these, two applications were rejected at an early stage, being in direct conflict with other applications that we were simply unaware of at the time. About 27 have been subject to searches, some still on going, some progressing to the next stage. Six of these are unlikely to proceed in their current form, having been given "X"s by the patent office for some of their claims (indicating a lack of originality in some of the claims to originality made in the application), and "Y"s for others (indicating that the applicant has made a step that looks obvious and thus lacks genuine originality). Two have been patented in the UK (this being the cheap option), and one is being patented internationally (this being the expensive option). In addition, students reported considerable gains from attending the course in terms of their confidence regarding the processes of invention and innovation, which are often shrouded in mystery and assumed to be the province of technical and engineering types. Others appreciated that even if their idea goes no further than the publication of a patent application, this alone is concrete – independently assessed – proof of their ability to do something entrepreneurial.

Conclusions

The author concludes from this experiment that invention can, indeed, be taught: not merely brought out in those who have some predisposition towards it, but purposefully and systematically developed in those that do not. The author believes there are four reasons why this is possible: first, because part of the inventing process is nothing more than learning the patenting procedure, it can be taught in a traditional manner (should any reader require it, the patents cited in this paper may be freely used as templates to copy the standard layout). Second, because everyone is creative in some way (at a bare minimum everyone can "make stuff up") this creativity can be transferred to the invention of commercial products, albeit using less traditional teaching methods. Thirdly, because techniques can be developed to build a more rational invention strategy, as demonstrated by the BRAINERS approach discussed above. Finally, because a greater degree of alertness to new opportunities can be

developed independently of the extent of students' prior knowledge. For future practice the key elements of the approach discussed in this paper would appear to be eminently transferable, and details of both the practice of creativity transfer and of the BRAINERS analysis are available from the author, on request. Further research on these and other techniques aimed at achieving the same results are recommended by the author, and to facilitate, this no protective claims are made regarding any technique mentioned in this paper.

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Paper 6

Clark, A. (2010) "Educators vs. Entrepreneurs: Traits and bias in the teaching of SWOT". *Journal of Further and Higher Education*. 35(2): 1-14.

Educators vs. entrepreneurs: traits and bias in the teaching of SWOT

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A study of the marks allocated by 10 tutors to 263 students' SWOT (Strengths, Weaknesses, Opportunities, Threats) analyses on a range of business education courses reveals a largely hidden assumption regarding the balance of the four factors. To investigate the significance of this in light of the suggestion in the trait literature that entrepreneurs are born optimists and therefore are likely to emphasise S and O, above W and T, a detailed study of 10 entrepreneurs' approaches to SWOT was undertaken. This confirmed that, as expected, entrepreneurs' views do not gravitate towards balance in the same way that those of tutors do. However, subsequent quantitative and qualitative evaluations reveal that this is not solely indicative of a bias towards optimism by these entrepreneurs, since in more than half the cases considered it was the traits of tutors towards balance and inclusivity that seem to be misplaced. This conclusion leads the author to suggest that tutors abandon this assumption and accept that the degree of balance will vary.

Keywords: SWOT; pedagogy; enterprise and business education; entrepreneurial traits

Introduction

The purpose of this research is to make a contribution to the debate on what works in business education, and why. Particular reference is made here to 'enterprise' courses, since although there is tentative evidence that enterprise programmes encourage entrepreneurial intentions regardless of the audience (Souitaris, Zerbinati, and Al-Laham 2007), how they do this is unclear. Indeed, there is a lack of information on both what is actually taught (and learnt) on such courses, and what effect different elements of it have on students' entrepreneurial abilities or inclinations. So, while we are witnessing a significant rise in the number of such courses, quite what they achieve, and how, is open to debate. One thing that seems to be widely taught on such courses is SWOT (Strengths, Weaknesses, Opportunities, Threats), in which the 'external' opportunities and threats facing an organisation are considered

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in combination with a review of the organisation's 'internal' strengths and weaknesses.

History, methodology, and standard criticisms of SWOT

SWOT analysis is often traced back to Harvard and the work of Learned et al. (1969), or, alternatively, to Albert Humphrey's SOFT analysis, which appears at around the same time and seems essentially the same as SWOT, except that 'Flaws' replaces 'Weaknesses'. What is perhaps more clear is that its initial popularity was largely down to the efforts of Kenneth Andrews (1971) in his promotion of the idea that corporate strategy should be framed in terms of the need to match internal factors with external developments. With hindsight, this can be seen as part of the process by which strategy broke free as a discipline from the environmental determinism of neoclassical economics with its emphasis on the primacy of O and T (Clark 2003) – by, in short, showing that S and W matter too (Rumelt 1984, 1991). The result is that in the classroom today all four factors tend to be given equal weight, and the utility of this can be gauged by the scale of its adoption, which now encompasses all kinds of evaluations (for a recent example, see Allan and Clarke 2007). SWOT is now commonly used within business too, particularly in the strategy formulation process, as confirmed by Jarzabkowski and Giuliatti (2007), who, in studying a sample of alumni from UK business schools, found that SWOT was the most widely reported tool surviving the transition from college to work. However, while the success of SWOT cannot be denied, Jarzabkowski and Giuliatti (2007) also found that the reported usefulness of SWOT was low, and diminished further as the strategy process progressed. In effect, its reported usefulness declined as the needs of the former students shifted from categorisation and interpretation towards policy formulation and, ultimately, action. This confirms earlier work on the utility of SWOT in strategy formulation, which Pickton and Wright (1998) summarise as an 'incremental, non-rational and irregular' process that is 'more organic than mechanic' (109), and in which we should not, therefore, be surprised that tools like SWOT, which they categorise convincingly as mechanistic, have declining relevance. This view echoes Valentin's (2001) finding that 'traditional SWOT analyses often yield only shallow extemporaneous inventories that are as likely to detract from critical issues, themes, and thrusts as illuminate them' (54). A harsh summary, perhaps, for such a widely adopted tool, but some commentators go even further and suggest that SWOT can actually do harm. Menon et al. (1999), for example, show that SWOT can be counterproductive in the formulation of effective marketing strategies, and Hill and Westbrook (1997) go a long way to showing why this is so, as it leads even professional management consultants to recite strengths and weaknesses that are simply the same point reversed, and to resort to lists of cryptic phrases, such as 'poor product quality', with little or no clues regarding which products are involved, in what ways and why, how

we know the scale of the problem, or, indeed, anything else that might make SWOT of practical strategic relevance. However, although the critics of SWOT are numerous and often venerable (Mintzberg 1994, for example), none have managed to strike a blow of sufficient force to see SWOT abandoned either in business or in business schools, where its perceived benefit in getting students started on the important task of investigating firms in some kind of contextual way is highly valued. Neither are such criticisms the substance of the research presented here. Rather, in what follows the focus is on the assumptions employed in the pedagogic practice of SWOT.

The study

In order to assess what is learnt about SWOT in practice, it was decided to focus on the assessment side, rather than looking at the teaching inputs. In pursuit of this, 263 assignments in which students were required to undertake a SWOT analysis were reviewed for a number of courses over the period 2002–07, some as part of a programme developed by the University of Glamorgan that is taught at a number of colleges in Wales and across Europe, and some from elements of the Chartered Institute of Purchasing and Supply professional exams (prior to recent syllabus changes). In total, this encompasses the marks given by 10 tutors. The tutors were predominantly not experienced business people, although three had worked in the private sector, and one had run their own business – a management consultancy. The majority had inherited the requirement to teach SWOT, and this raises the question of their intrinsic commitment to it. However, all felt it was an important tool and in all cases they had some input into the form of the assessment of it.

In order to benchmark what is being learnt, some of the firms under study were invited to comment on the students' findings. In one case in particular, the entrepreneur who established, and continues to run, one of the companies (SimWood eSMS, company number 03379831) was able to comment at some length. However, in doing so it became apparent that he did not see the four SWOT factors as equally applicable, which contrasted with how tutors saw it. This could simply indicate that the entrepreneur is wrong, of course, but it might equally point to a bias in the pedagogy (notwithstanding the fact that the bias would be towards reporting a balance), since while it may be important to assert the principle that all factors might be equally important, *ex ante* (as discussed in the preceding section), this is not proof that they are, *ex post*. It was decided, therefore, to investigate, first, whether this balance was sought by tutors, and, second, whether this could be justified. This required two studies combining a mixture of quantitative and qualitative research: first, an empirical study to determine whether tutors were, in fact, looking for balance *per se*; and second, something to determine whether it matters. To investigate the latter, it was decided that a series of in-depth interviews would be conducted with 10 entrepreneurs to establish whether they put any value on a

balanced approach. This entailed getting them to do a SWOT analysis, which was subsequently discussed and evaluated. This evaluation was done both qualitatively, with the authors' reflections on some of their comments reported below, and quantitatively, by measuring the subsequent fortunes of their firms, both compared with those of rivals, as a gauge of their strengths and weaknesses, and in terms of their industry relative to all industries, as a gauge of the opportunities and threats.

The selection of the 10 was based on a number of conditions in order to get as close as possible to the ideal type of entrepreneur most likely to fit with the overly optimistic entrepreneur found in the trait literature. Specifically, it was determined to choose successful entrepreneurs rather than merely representatives of successful enterprises. So, one criteria applied was that the firms to which the SWOT would be applied would have been both established and still largely run by the entrepreneur being interviewed. Another criterion applied was that the firm should have been operating for more than three years, to eliminate those still in the start-up phase. A final criterion, aimed at eliminating the chances that the entrepreneurs had been specifically taught to look for balance in SWOT, was to confine the study to entrepreneurs who had not been formally taught how to do a SWOT analysis, although – somewhat inevitably – all of the chosen 10 had heard of it.

Findings

That a balanced SWOT report is expected by tutors receives some support from a simple regression of marks against a measure of balance based on the coefficient of variation of the number of points made by each student under each SWOT heading. This is indicative only, however, since the extent to which this measure is independent of quality is difficult to establish definitively when the only measure of quality we have is the marks given by the tutor. The balance requirement was not made explicit by any of the tutors, although one came close, and all tutors indicated in some way that all factors should be considered, with a complete blank under any one heading being regarded as unacceptable by staff and students alike. In light of this, answers where students failed to write much at all about anything were eliminated from the sample on the basis that the balance they display cannot be considered in any way independent of quality, since the students had given themselves too few words to play with.

Table 1. Regression results.

Adj. R ²		Coefficient	Std Error	-95% C.I.	+95% C.I.	<i>t</i>	Prob.
0.58	Intercept	60.2	0.658	58.9	61.5	91.5	0.000
	Balance	-17.8	0.940	-19.6	-15.9	-18.8	0.000

If we plug in the regression coefficient for balance into our entrepreneurs' SWOT results, we find that, *ceteris paribus*, over half would be in danger of failing the assessment, with four of the 10 getting a mark below the required pass mark, and two lying close to it. This is significant, as we would normally expect one or two out of 10 to fail. This finding is given further support from a subsequent postal sampling of 31 entrepreneurs, where although lack of familiarity with SWOT and other elements of the requirements discussed above cannot be guaranteed, a larger sample could nonetheless be collected. In this case, 35% would fail if we apply the estimated regression parameters. We can, of course, console ourselves with the thought that the same high failure rates could be found for any subsample of the students too, prior to their learning of the importance of taking a more balanced approach to SWOT. However, while entrepreneurs are probably as likely to pick up on this as much as anyone else, this finding does at least create a need for educators to reflect on whether this assumption is valid, and if it is, whether it should be made explicit.

To assess the validity of the assumption, it was decided to focus on falsification, and thus on the comments of the unbalanced entrepreneurs (so to speak) in particular, rather than on confirmation by looking at the rest (or indeed at all the cases covered in the 263 assignments). In looking at the cases of the six least balanced entrepreneurs, a number of things stand out. First and foremost is the emphasis on opportunities and strengths. Comments on this finding by tutors tend to revolve around the hypothesis that entrepreneurs' perceptions are skewed towards an unwarranted degree of optimism, this being a widely touted trait of entrepreneurs, which tutors felt was, as Guth, Kumaraswamy, and McEarlean (1991) suggest, an 'internal' view that they could be taught to overcome to take a more objective 'outside' view, like that taken by tutors. As a result, while tutors tended to acknowledge the fact that a positive mental attitude may be useful in business – as Crane and Crane (2007) found, the findings presented here were not greeted as something that tutors could learn from entrepreneurs, but exactly the reverse, which seems a little odd on an enterprise course where emphasis is often placed on what we can learn from entrepreneurs – though it could well be correct. However, in looking at the individual cases, I conclude that it is at least as likely that it is the traits of tutors, in their desire towards balance and comprehensiveness, that are questionable.

The difficulty of proving this quantitatively either way should not be underestimated, since it rests on the meanings applied to words such as 'threats' and 'opportunities', which are loaded terms, being designed to convey strategic imperatives, so that firms following it become what Barry and Elmes (1997) describe as 'epic journeyers, systematically navigating towards opportunities and away from threats' (440). Indeed, it could be argued that since the four 'unbalanced' entrepreneurs are still in business despite the recession, this is some kind of proof that their emphasis on opportunities was vindicated, strategically, by events. However, it may equally reflect their ability to steer

away from the threats. With similar comments applicable to the strengths and weaknesses, what is required is an examination of the comments made by the entrepreneurs, and some means of evaluating them that can distinguish between the different forms of navigation. In what follows, a tentative attempt at such an assessment is made in both qualitative and quantitative terms.

Qualitative evaluation of entrepreneurs' comments on strengths and weaknesses

The results from the SWOT exercise and subsequent discussions of their thoughts on this show that the 'unbalanced' entrepreneurs favour S over W. However, their comments suggest that they felt that weaknesses were something that it was their job to eliminate, and I got the impression that part of their failure to mention these may stem from their reluctance to admit that they had not done so. However, I was also left with the impression that what others might see as a weakness from the outside can often be more accurately interpreted, from the inside, as the result of sound strategic choices. For example, one of the entrepreneurs felt he could have taken his firm into a bigger market, but chose not to, and refused to accept the outsiders' view that this was indicative of his firm's inability to service the larger market and thus a 'weakness', since it 'was a choice we made' to 'focus' on the top end of the market – a choice subsequently vindicated by events. Of course, it may be argued that anything in which a firm is not the biggest or at which it is not the best can be interpreted as a weakness, but for the most part weaknesses are not simply presented as an invitation to benchmark the firm in this rather vacuous way, but rather entail some evaluation of whether such things are failings of strategic significance or not. Indeed, the entrepreneurs in this study seemed well aware of the fact that such facts can be interpreted in different ways – the fact that a small market share could be seen as a weakness or a strength being mentioned by more than one. Nonetheless, for the entrepreneurs in this study, the term 'weakness' implies some 'wrong strategy', and it is in the context of a mindset bent towards strategic usefulness that their comments on SWOT tend to be framed. To highlight the differences between the assumptions of tutors and those of the 'unbalanced' entrepreneurs regarding weaknesses, it is worth looking in detail at one example where the two views collide directly, in terms of one strategic imperative: beating the competition. Beating the competition is assumed by many tutors to be a primary motivator of entrepreneurs. However, in the case of SimWood, the entrepreneur explicitly denied that this was a major objective; it simply 'wasn't the point'. The fact that SimWood is much smaller than many of its rivals (such as the telecoms giant BT) led many students to conclude that its size was a 'weakness', while the entrepreneur in question was more inclined to see it in terms of enabling greater flexibility, since his greatest successes and the things that gave him greatest satisfaction (and which are given emphasis in the company's website

and publications) stemmed from speed and creativity and innovation, that are often stifled by great size. Further evidence that the cognitive error in this case may not lie with the entrepreneur is provided by Messick and Thorngate (1967), who found that students (in following the advice of their tutors) overreact to competitor information, and by Leeflang and Wittink's (1996) findings that they may carry this on into their practice as managers. It is also the case that in the industry in which SimWood operates, some of the disadvantages of being small may not apply, because the link between lower cost and greater size is weak as some traditional economies of scale do not apply (Hui 2000). In sum, then, we should at least grant that this entrepreneur might have a point.

The entrepreneurs' comments on opportunities and threats

While the idea that optimism is intrinsic to the entrepreneurial mindset is ubiquitous in the trait literature, specific evidence on whether this is rational and appropriate, or merely indicative of bias, is scarce. One study, by Arab-sheibani et al. (2000), suggests that, in the UK at least, the self-employed may be inclined to an element of unfounded optimism, while de Meza and Southey (1996) suggest that such over-optimism is a significant cause of high start-up failure rates for small businesses. In addition, the degree of turbulence (Burns and Stalker 1961) and thus uncertainty (Knight 1921) facing some of the businesses in this study makes the author suspect that the entrepreneurs were not just overstating the Os but understating the Ts too (notwithstanding the fact that this information was gathered just prior to the latest economic recession, after which we might conclude that almost everyone had been underestimating the Ts). However, many of the comments of the 'unbalanced' entrepreneurs in this study suggested that this was more than blind optimism and that some care had been taken in formulating their expectations. Indeed, despite the fact that the 10 sampled were chosen on the basis of their lack of familiarity with SWOT, they were aware that some comments at least were expected on each of these factors, and any decision to underplay some points was therefore done in defiance of this. For example, one of the entrepreneurs questioned was in the process of taking a public-sector charity and turning it into a social enterprise (company number 06973271), a kind of pioneering privatisation about which many people in the UK – including the entrepreneur in question – had significant misgivings, and one that she described as putting her into 'a goldfish bowl' of inspection by all manner of interested parties and onlookers. She saw this as a great opportunity for her to be regarded as an innovator, but one could equally have concluded that she was driven in part by the threat of failure. The point, however, is that in choosing how to describe this – in other words, in determining which box to put this development in – she was led not by blind optimism but by a careful consideration of the facts that had led her to

conclude that the external factors were favourable to this kind of development in a way that they had never been before, or, as she put it, because 'everyone wants it to work'. Indeed, when confronted with the need to apply a more balanced approach on reporting this issue, she specifically called on me to 'prove it', which is the issue to which we now turn.

Quantitative evaluation of entrepreneurs' comments

Another way of evaluating the comments of the entrepreneurs, and thereby, possibly, of proving whether or not a more balanced approach is called for, would be to conduct some benchmarking exercise. To this end, the author has taken the revenue figures for the firms of the 'unbalanced' entrepreneurs for the period of their comments up to the end of the corresponding year and compared these with other industries, as an indicator of the opportunities and threats in their industry, and against other firms within their industry, as an indicator of their strengths and weaknesses within that industry. Putting these together on one graph gives some visual measure of their proximity to the mid-point, which is synonymous with the point of balance between the SWOT factors. This quantification is to the nearest percentage point, but like all attempts to quantify the meaning of qualitative differences, the figures need to be taken as indicative only, particularly as the industry figures suffer from aggregative 'lumpiness' which could be as large as the differences observed. Notwithstanding this, there is a clear indication, as shown below, that aiming for the middle of the graph – where the opportunities are no more significant (as it turned out) than the threats, and the weaknesses are no worse (relative to the competition) than the strengths were beneficial – might be misleading. Indeed, if we cross-tabulate the SWOT parameters to get SO, WO, WT and TS pairs (an approach favoured by some, but rarely used in practice), then we can see from the graph that a discussion that focuses on S and O would be more justified than a balanced approach, for at least five of the six cases.

We may tentatively conclude from this that a balanced approach to SWOT is unwarranted in these cases, both in terms of a qualitative evaluation of the explanations provided by those most closely involved with them, and in terms of the quantification shown above. Any tendency, therefore, to treat those explanations as invalid on the basis of entrepreneurial over-optimism is, on the whole, unfounded. This has implications for students as it undermines the widely held view that SWOT, though flawed, is a harmless way to start students on the task of contextualising organisations, for if it does not facilitate dialogue on their internal and external position in a neutral way, and given that attitudes affect behaviour (Ajzen 1987), there is a risk that teaching it could have negative consequences for the development of students' strategic and entrepreneurial skills. This calls into question the whole-scale and uncritical transfer of SWOT to enterprise programmes where the development of such skills is a particular concern.

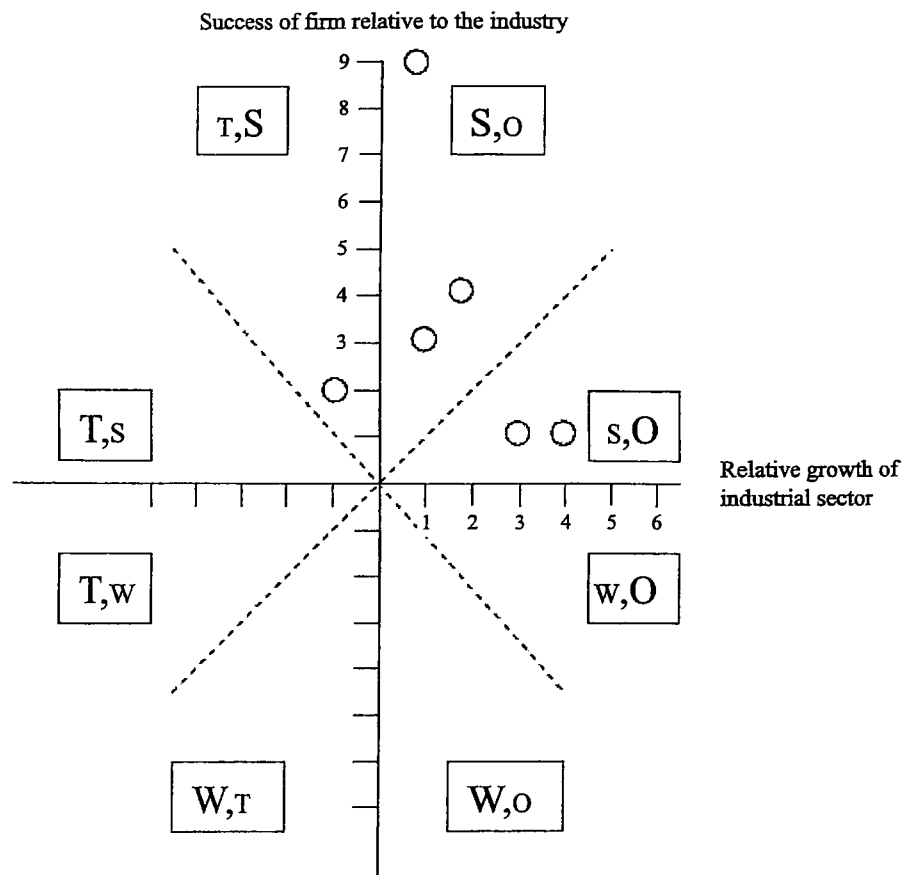


Figure 1. Relative growth of total revenue/turnover of the six 'unbalanced' firms.

Conclusion

Much of what is taught under the banner of 'enterprise' courses is actually traditional business studies, rather than the aspects of enterprise that differentiate it from this, such as creativity and the ability to spot opportunities (Kourilsky 1995). This is not to deny that some pedagogic differences exist; in particular, it is possible to detect a greater emphasis on business start-ups and developing new ventures. However, even here the focus seems to be on learning the procedures and processes and business-plan writing skills that such innovations necessitate, rather than on encouraging the development of the inventiveness, creativity and opportunism that give rise to such innovations in the first place (Kuratko and Hodgetts 2004). In light of this and similar findings, teachers of entrepreneurship are now being called upon to 'expand their pedagogies to include new and innovative approaches' (Solomon, Duffy, and Tarabishy 2002, 82), a prerequisite of which must surely be to reflect on what we currently do

as educators and why, and how it relates to what entrepreneurs do and how they think about the same issues. Doing this for SWOT suggests not only that there is a divergence between the two, but that this may be as much to do with our misperceptions as with theirs. Of course, as tutors we need to embrace tools that have widespread applicability, particularly as psychological research suggests that transfer of learning across situations is often disappointingly weak (Loewenstein 1999). However, in this article we have seen that the way we assess what students make of SWOT means it is in danger of becoming an embodiment of what Chia and Holt (2008) describe as management knowledge based on 'representation' rather than on 'exemplification', with these representational advantages guaranteeing the continued use of SWOT, regardless of the fact that they exemplify the wrong mindset, with the possibility – exemplified by our 'unbalanced' entrepreneurs – of those who correctly identify the key strategic issues being marked down if those issues do not happen to fall in a balanced way – in other words, of being marked for form rather than for substance.

That we can justify the downplaying of W and T in this way by our 'unbalanced' entrepreneurs does not mean, however, that we can conclude that these are less important, *a priori*, than S and O, and the possibility that entrepreneurs can learn something from tutors' insistence that these be given equal attention should not be dismissed. Indeed, while one of the entrepreneurs in this study presented his decision to close a retail outlet for his engraving and sign-writing business almost entirely in terms of opportunities (i.e. to concentrate on production in his industrial units) and strengths, to my mind it could equally have been interpreted as a response to the threat of declining retail sales resulting from the advent of the Internet, where they were weak. Describing it in positive terms reflected how the entrepreneur presented it at the time, which helped to motivate both himself and staff to enact the best outcome (Weick 1979), but it is a moot point whether phrasing it in terms of threats and weaknesses would have led to different, but possibly equally significant, gains. However, the fact that at least one entrepreneur in this study displayed an element of prejudice in choosing which categories to employ (albeit for strategic reasons) means only that tutors are right to insist that all factors be given equal attention at the start of a SWOT analysis. It is not a justification for assuming their equality *ex post*. The correct pedagogic conclusion is, therefore, that the entirely laudable aim of tutors to encourage students to adopt a balanced approach to the consideration of SWOT factors needs to be separated from the desire to see equality in the reporting of the significance of each, as this is an assumption that needs to be tested on a case-by-case basis, and using SWOT is unlikely to lead to good strategy development unless and until it is.

Recommendations, and suggestions for further research

This research shows that tutors need to reflect on two issues in the use of SWOT: first, that any presumption of balance should be made explicit; and

second, that, unless tutors have evidence that the case in question warrants it, the presumption of balance should be dropped, with any desire to see evidence of a balanced approach to the consideration of factors in a SWOT analysis being clearly separated from any requirement to produce a balanced conclusion on their significance.

For further research, the author would also recommend two things: first, that consideration be given to how best to achieve the separation, discussed above, within the SWOT framework; and second, that further research is conducted into the link between what we teach and why, and what entrepreneurs think and why, and what tools work and why, since, as Ottewill (2003) found, there is increasing pressure from students to focus our efforts on those things that have been clearly demonstrated to be useful in practice.

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Paper 7

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De-Mystifying Inventive Thinking: A Survey With Pedagogic Implications

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ABSTRACT

Students on an enterprise course running in a number of colleges in the UK in which invention and innovation formed part of the curriculum were asked to complete a questionnaire immediately upon having an inventive thought in an attempt to establish the thinking processes involved. Results from those who had ideas that subsequently proved to be genuinely inventive are presented in this paper. The results show that such thinking is most frequently categorised by the thinker in terms that suggest it is similar to other everyday modes of thought, rather than anything more mysterious. The implication of this research is that accessing the kind of creativity required to begin students inventing is not as problematic as has previously been assumed, although it can be made so by approaches that fail to take account of the need for problem construction and the need to overcome the inertia created by the extent to which invention has been mythologized in the minds of both students and teachers.

Keywords: Teaching Invention; Inventive Thinking; Psychology of Creativity

BACKGROUND

In 1945, Vannevar Bush published a paper that outlined the principles of hypertext. By the 1980's, hypertext had spawned such a plethora of modes of communication between computers that users were crying out for standardisation. One such call came from Tim Berners-Lee, and the first node of a standardised system that we now know as the Internet was established in his office using the NCSA's hypertext based Mosaic system. This story, brief as it is, highlights a common feature of great inventions - rapid assimilation after diffusion, but gradual accretion prior to it. However, if we ask who invented the Internet, we tend to get the answer 'Tim Berners-Lee'. This reflects a tendency that people seem to share to cut a long story short by personifying a great idea in a great person; to ascribe it to individual genius. It may seem very reasonable to assume that something exceptional should be the product of someone exceptional, or at least of some exceptional thoughts; but the results presented in this paper challenge that assumption. This is not to say that the 'great man' view of invention has never been challenged before. Authors, such as Bijker (1987) and Hughes (1983), challenge it by showing how many of today's industries were built on dispersed inventive elements while others, such as Scranton (1977), Allen (1983), and Meyer (2003), highlight the importance of collaboration and interaction in bringing such elements together. The challenge made here is, however, rather different; the issue being less about whether inventions rely on the efforts of exceptional people - or not - and more about whether the thinking employed is, itself, exceptional.

INVENTIVE THINKING, PSYCHOLOGY, AND NEUROSCIENCE

In psychology literature, there is little on inventive thinking per se, but there is a considerable amount of research into creativity; and since - as Morgan (1953) points out - definitions of creativity share a common emphasis on novelty and originality with invention, this can be assumed to encompass the standard view of what inventive thinking entails. The literature on creative thinking should, however, be viewed in the context of the failure of psychologists to identify the underlying processes involved in thinking, in general. As Stanovich and West (2000) show, the development of a theory that, by encompassing the most significant findings to date, could lay any claim to generality (Hendry and Richard, 1989) is proving elusive and what we have instead is a proliferation of dichotomies between different types of thinking - associative versus rule-based, experiential versus rational, implicit

versus explicit, and so on and so forth. In addition, although authors, such as Stanovich and West (2000), have done their best to tidy things up, it seems inevitable that dichotomous approaches - being primarily descriptive - will continue to proliferate in the absence of anything more profound. The dichotomy most often used to distinguish creative from other forms of thought emphasises its supposedly intuitive, non-linear, lateral, divergent and unpredictable nature. This specific bifurcation was given a huge boost in the 1960's by brain research of Roger Sperry and others who found certain polarities between left and right hemispheres. One such being is that information processing by the right hemisphere appeared to exhibit gaps that were less apparent on the left, possibly relating to the visual processing dominance on the right and verbal processing dominance on the left. In the popular media, this translated into the view that there was one creative hemisphere and one analytical one, with the creativity resting on something that had not been explained since the gaps indicated thoughts that emerge with no immediate precedence or, as it is often phrased, 'like bolts from the blue' (sky). Interpreting these gaps as intuitive leaps, rather than as limitations of the research, confirmed the view that creativity is intrinsically mysterious. Even in the scientific community, absence of evidence tended to be taken as evidence in concluding that the inner workings of the brain showed creativity to be something extraordinary.

Today we live with this legacy, one result of which is that radically different pedagogic approaches are often taken to bring out the creative side of students. One of the best known proponents of the validity of this difference is Edward de Bono, who argues that breaking free of ordinary thinking is a prerequisite of inventive thinking. Indeed, the argument that ordinary modes of thought have to be transcended to liberate the creative ones is forcibly expressed in many self-help books, as Koestler (1975) puts it - "The creative act...presupposes a relaxing of the controls and a regression to modes of ideation which are indifferent to the rules of verbal logic, unperturbed by contradiction, untouched by the dogmas and taboos of so-called common sense". (p.165) Of course, part of this distancing is motivated, in some at least, by a desire to sell self-help books and the like (Hines, 1987). However, it cannot be dismissed easily since this separation is ubiquitous in the academic literature too, (see, for example, Finke *et al.*, 1992). Indeed, although Heilman *et al.* (2003) admit that there are no firm conclusions from this research as yet, they seem to be nonetheless content to conclude that creativity entails something out of the ordinary - "creative innovation might require the coactivation and communication between regions of the brain that ordinarily are not strongly connected" (*ibid.*, p.369). As if that were not bad enough, although some neuroscientists recognise that "much more work is needed in order to establish reliable and valid measures of creative thinking, in particular measures of novelty or originality of creative insights" (Fink *et al.*, 2007, p.68), the fact that we may not have identified what it is has done nothing to stop competing teams of neuroscientists from trying to explain it. Moreover, it is possible to detect an element of assumed causality in discussions of creativity that is absent in other aspects of brain research. For example, a recent unpublished study by Geraint Rees and his colleagues at University College-London, showing a correlation between Tory political views and physical thickening of the Amygdala, led to a widespread discussion of the opposing possibilities in the media (Churcher, 2010, for example) - in short, that it was either caused by certain propensities of thought (since brain structure is not fixed) or was the cause of them. However, nowhere, even in what we might describe as the most popular of the popular press, was it seriously suggested that voting Tory could be wholly reduced to this thickening, particularly when what that party represents has changed so much in recent years. In contrast, discussions of creativity, which the story of modern art and literature teaches us, is equally changeable and certainly more open to interpretation than support for a political party is often crudely reduced in this way, and not just in the popular press.

The fact that people use one part of their brains when solving well-defined problems and another when engaging in more creative thinking (Fink *et al.*, 2008) is not the issue. Rather, it is the interpretation of this result as it is apparent that those conducting such tests tend to assume that because the results of creative thinking are often exceptional, then creative thinking itself must be exceptional. Even those psychologists, who point to the need for a more rounded and holistic approach to the issue than brain-mapping provides, are often motivated by its rarity and the need, therefore, to get more of it occurring (Sternberg, 1985; Sternberg and Lubart, 1995). However, its rarity as a mode of thought is not established by studies in which it may or may not be correctly identified and in which we cannot find it anyway, 'coactivated' or not. So, we are forced back on the rarity of great art and major inventions as indicators of the rarity of the kinds of thoughts that give rise to them. The frequency with which we use our creative imaginations in our everyday lives, not just in obvious ways like daydreaming, but in imagining different scenarios for all manner of daily decisions, remains unknown, however, and the possibility that creative thinking is unexceptional remains a distinct possibility. In addition, recent research by Meneely and Portillo (2005) suggests

that creativity requires not adherence to a particular cognitive approach, but the ability to adopt and adapt different styles, which points to complexity rather than something amenable to reduction. A complexity which is further complicated by social interaction, since as Kurtzberg (2000) found, adding apparently 'non-creative' participants into a group of apparently 'creative' individuals can lead to greater creativity - not less.

Very little of the psychological research referred to above relates to invention per se, although some specific forms of creativity have been studied using brain scanning techniques - for example, by Geake and Hansen (2005) and Chavez-Eakle *et al.*, (2007) - which could be used to look at some forms of inventive activity. Duch (2007), for example, suggests that we may be able to scan people in the act of making very simple 'inventions', such as the forming of novel words from suggested word pairings. This is not what we would generally mean by the term invention, however, and is a long way short of what the students involved in this study have achieved. In the future, we might expect that many of the activities undertaken by the students in this study (as described in Clark, 2009) could be done while some form of scan is undertaken when brain-scanning technology shrinks in terms of both cost and bulk. Until this is done, we have to conclude that it is only an assertion that inventive thinking and other everyday modes of thought are radically different. That this assertion is, at least, greatly exaggerated is supported by historical studies of some major inventions undertaken by Weisberg (1993) which showed that many inventive 'bolts from the blue' evolve and accumulate rather more slowly than the analogy to lightning would suggest. Indeed, in reading many of the cases he refers to, it is hard not to be struck by the similarity between inventive thinking and the thinking routinely employed by scientists in generating hypotheses and conceiving various alternatives in the lab - or, indeed, much difference between this and the degree of imagination students employ in generating hypotheses and conceiving alternatives about which nightclub to go to at the weekend. Of course, many cases of invention are, in fact, scientists working in laboratories and often the two get mixed up; and in some cases, inventors are happy to encourage the mixing when it suits them. At Edison's invention factories, for example, every invention was attributed to Edison's final twist on ideas that his scientists may have been working on for years, even if that twist amounted to no more than the signing of his name. This is not to suggest that this is typical, but we might expect, at a bare minimum, that those so labelled are unlikely to be the first to challenge the 'great man' story of invention. The question addressed in this paper is not, however, whether a particular outcome is more to do with perspiration or inspiration, but what kind of thought processes are involved at the moment of greatest insight either way, which this kind of historical investigation cannot answer. Even when it is possible to ask those involved to reflect back upon their thinking, it is problematic since time will have elapsed; and in that time, any thought is bound to take on all kinds of different significances if it proves to be a great one. The solution used in this study is to ask those who have an idea to catalogue it against a list of thinking types commonly found in the literature immediately after having had the idea, regardless of the fact that at that stage its inventiveness is unconfirmed.

THE EXPERIMENT

This study relates to an experiment in teaching invention undertaken at the University of Glamorgan and its associated colleges in Wales (mostly) and England, entailing a range of activities aimed at encouraging students to invent, as outlined in Clark (2009). The number of participants in the experiment is large, but the number in this study is only 30 because the survey is based not on the number of participants or the number of ideas generated, but only on those ideas that have been patented or sent forward for formal examination by the patenting office (having passed both an in-house test of patentability and having been judged worthy of the financial backing that such progression requires). A problem with this approach is that since the number of patentable ideas is small relative to the number of participants, more than one cohort of students is covered and, as a result, the experimental conditions cannot be assumed to be identical in different years.

The questions in the survey, as shown in the Appendix, relate both to some general conditions and impressions, as well as a self-assessment of the thought process that led to the idea, using a classification of types of thought which had been previously discussed with the students. The form was filled voluntarily by the students whenever they felt that they had come up with a good idea in an attempt to capture their thoughts on their thinking as contemporaneously as possible. Since at the point of having the idea the student is unaware that they may not have been the first to think it, the questionnaire was designed to be short (one piece of A4 paper) and easy to complete in class or at home. The alternative would be to look at all ideas; but in this context, such a strategy is flawed since there is no way of knowing whether the respondent is genuinely unaware of it, even subconsciously.

GENERAL RESULTS

Although the focus of this paper is modes of thought, other related issues were briefly investigated. One obvious question was whether the successful ideas came from people who felt creative, which seemed to be the case with 67% support for the first question. However, it is just as interesting to look at it the other way around and note that one-third of the people who were most successful at this creative task did not see themselves as creative, confirming one of the tenets of the original experiments that being a creative type was not a necessary prerequisite. Another issue is whether working in groups encourages invention, which is of particular interest here since different modes of thought may be engendered by interaction. Some authors claim to have quantified clear and significant gains to group work in generating ideas. Osborn (1957), for example, suggests that a group could generate twice as many ideas as the constituent individuals working independently, using his 'brainstorming' approach. This claim has, however, been criticised (Taylor *et al.*, 1958, for an early example), and once we standardise for quality, the benefits of group work in this area have been observed to evaporate (Diehl and Stroebe, 1987). Nonetheless, since there is at least the possibility that group work might help, and given that the original idea of this work was to encourage invention, both individual and group approaches were employed and can now be compared. Indeed, since the test employed here is, in large part, standardised for quality, this research may be considered to have an advantage over previous studies. In doing this, every effort was made to make it a fair test by tackling issues that are seen to inhibit good group thinking. For example, the suggestion that members of groups may feel inhibited about revealing their most bizarre ideas (Lamm and Trommsdorff, 1973), of really letting go of their social inhibition in the group situation (Jablin and Seibold, 1978) led to an approach being adopted that encouraged outrageous ideas from the start. This cannot, of itself, eliminate the sideways glance or wry smile which may be all it takes to note disapproval in a small group setting, but it is likely to have helped create a mood in which inhibitions were reduced, although the effect of this is unclear as less than half supported the statement that 'coming up with strange ideas is a necessary part of the inventive process'. To what extent the success of group work can be attributed to how it was done is therefore still a moot point, despite the fact that the results presented here are very positive for group work with 87% of respondents agreeing or strongly agreeing with the statement that 'the group brought out my creativity'. Indeed, in the evaluation of the thought processes, 'An idea that someone else had in the group made me think of it' was the second most popular answer. This is not to say that the groups always gelled, of course, and regrettably, we cannot draw any conclusions about the relative proportion of ideas that result from group work given the dynamic nature of the class activities, although it is probably fair to say that more than half entailed some element of group interaction. In the questionnaire, there is also some support for the findings of a recent study by Baer *et al.* (2010) showing that competition encourages creativity, as 80% of the sample agreed or strongly agreed with the statement that they 'wanted to beat the others in this task'. Indeed, although collaboration and competition are often juxtaposed as opposite paths to greater productivity, in this case we see the importance of both simultaneously in generating successful new ideas, with significant overlaps between wanting to beat the others and recognition of the benefits of group work. Another significant issue was gender as most well-known inventors have been men. This could be due to the relatively inventive nature of their thinking, a notion supported by 70% of the students in this study who agreed that 'Men are the best at invention because men think differently'. Or it could be due to historical differences in the status and roles of the different sexes, which is supported by the fact that almost half (47%) of the successful ideas in this study actually came from women. A final issue that was investigated was motivation, with this being tackled both by a direct question regarding the respondent's desire (or otherwise) to do well in the task and by an assessment of their disposition toward it by asking whether they had enjoyed it or not. Both of these questions elicited strong support (63% and 70% strong agreement, respectively), indicating that success in this task was related to effort, application, and modes of thought that can be bent to the will rather than anything more mercurial.

SPECIFIC RESULTS ON THOUGHT PROCESSES

The most commonly cited category of thinking was Analogous Reasoning (47%), which describes situations in which we transfer what we know in one area to another; although when applying it to novel situations, this is also referred to as transduction in the psychology literature. Examples of where inventors transfer an observation from one context to another include George de Mestral's invention of Velcro following his observation of the way burrs stuck to his dog's fur. More generally, they relate to solutions in one area being applied to another - in gadget terms, applying function A, that makes gadget X so good, to gadget Y. That this reflects the kind of thinking that might be described as ordinary or every day, rather than exceptional, is confirmed in the psychology

literature where we see comments, such as ‘analogy and similarity, are central in cognitive processing’ (Gentner and Markman, 1997, p. 45). Indeed, this type of reasoning is widely recognised as a skill that we all employ from an early age (Siegler, 2000).

The second most popular choice (23%) was that the idea resulted from what someone else in the group had said, which reflects the significance of interaction and is – again - indicative of something we all do every day, rather than something extraordinary. The remaining categories are all significantly smaller by comparison. One might expect that logical problem-solving (10%) might score higher, but in this context, most of the time students are constructing a problem rather than solving one (Getzels, 1987). To take this into account, the category of Alertness (10%) was also used, although this relates more to a general open state of mind, as discussed in Clark (2009), rather than a way of thinking per se. The hypothesis that the idea was a bolt from the blue, and therefore something of a mystery to the thinker, was supported in only one case, and the fact that, in general, the students were content to use the categories provided, suggests that the categories resonate in large degree. The exception in the sample relates to a case where the student could not identify the thinking as it resulted from an exercise in which students were forced to devise a product using random words without time to think, which seems to make it difficult to reflect on quite how the thoughts emerged. Nevertheless, although this could be seen as a bolt from the blue, it is the source of it that is semi-random, while the thinking rests on the interpretation of words and the degree to which words conjure up images, though magical they may be, cannot be considered exceptional.

CONCLUSION

While it cannot be denied that there is regional specialisation within the human brain, the results of this survey suggest that the current failure to find the ‘part’ that gives rise to creativity and invention should not be taken as evidence in support of the widespread notion that such a ‘part’ is intrinsically harder for the consciousness to access than other ‘parts’. The author is undoubtedly biased, having come to the view that inventive thinking cannot be as mysterious, as generally supposed, since it can be effectively taught (Clark, 2009); and concluding from this, that its rarity has probably more to do with states of the world, and the constraints they impose, than states of mind and their rarity. Despite this bias, the author, nonetheless, contends that the research presented here provides an element of independent support for that view. This is not to suggest that inventive thought is not mysterious, but only in the sense of Perkins (1981) who reminds us that all thinking is deeply mysterious and that to view everyday thinking as anything less is to skew the debate in favour of some form of dichotomy.

There are three broad pedagogic conclusions that come from this research. One is that the need for transcendence is removed, which may lead to a wider engagement with the teaching of invention and other creative pursuits within Business Schools and elsewhere. The second is that more students may feel able to engage in such activities, even if they have not previously labelled themselves as the ‘creative type’, if some of the mystery is removed. The final implication is that although there is a tension between the poorly-defined problems of invention and the emphasis in most educational programmes on well-defined ones, this does not mean that teaching invention necessarily entails engaging students in types of thinking that are alien to them because, although “ill-defined problems are ill understood by psychologists” (Pretz, *et al.*, 2003, p.13), students are able to rise to the challenge as “most of the problems in the real world are not well defined”. (*ibid*)

AUTHOR INFORMATION

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APPENDIX

PART 1 OF QUESTIONS

Student number:

For the following statements, please put a tick in the box that best reflects what you feel:

1. I am a creative type of person.

3%	30%	40%	27%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

2. I wanted to do well in this 'invention' task.

0%	7%	30%	63%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

3. The group brought out my creativity.

11%	2%	39%	48%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

4. I enjoyed this task.

0%	20%	10%	70%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

5. I wanted to beat the others in this task.

0%	20%	57%	23%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

6. Men are the best at invention because men think differently.

10%	20%	20%	50%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

7. Coming up with strange ideas is a necessary part of the inventive process.

40%	20%	20%	20%
Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree

8. Please state which class you are in:

9. Please state whether you are male or female: (53% male)

Please do not fill in this form if you are unhappy with the terms of use. Please briefly describe the idea:

PART 2 OF QUESTIONS

Please tick which of the following best describes your thought process that led to your excellent idea.

1. Lateral, or counterfactual, thinking (3%)
2. Analogous reasoning (47%)
3. Bolt out of the blue (3%)
4. Logical problem-solving (10%)
5. An idea that someone else had in the group made me think of it (23%)
6. Alertness (10%)
7. Other (please explain in the space provided) (3%)

NOTES