Popper, Creativity and Education

Introduction

Best known as a philosopher of science and social theorist, Karl Popper's (1902-1994) original interest and training was in the areas of education and educational psychology, and references to learning and schooling litter his work. However, it is only in recent years that a body of literature has started to develop on the implications of his ideas for education[1]. Predictably, perhaps, a great deal of this work has focused on a relatively narrow range of questions:

- How do children learn?
- How can schools facilitate this learning?
- What would a non-authoritarian schooling look like?

These are, of course, pretty fundamental questions, and, if Popper was on the right track, they are all the more important because the mainstream answers to these questions – the answers that are taught to training teachers and which influence whatever decision-making teachers have left - are fatally mistaken.

I would like to take the opportunity offered by this symposium to ask another question; one which has often been implicit within Popperian writing, but rarely explored in any detail:

- How can schools and teachers foster creativity?

It seems self-evident that the importance of creativity is becoming ever more critical. If Popper's approach is as revolutionary as we Popperians claim, then it ought to offer insight into important questions like this. I do not suppose for a moment that I can completely answer this question in this short paper. Rather, I aim to discuss some important issues, and consider possible lines of future enquiry.

The paper begins with a relatively brief statement of Popper's distinctive (and frequently misunderstood) theory of learning, and proceeds to offer an interpretation of that theory in terms of the so-called 'systems view'. The main part of the paper draws a parallel between Popper's theory of learning and a model of creativity, in which creative objects or ideas are understood as products of interactions between social institutions, cultural environments and individuals. It concludes by positing a series of strategies for the development and promotion of creativity within schools and society.

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[1] See, for example, Bailey, R.P. (2000) *Education in the Open Society – Karl Popper and schooling*. Aldershot: Ashgate; Swann, J. and Pratt, J. (eds) (1999) *Improving Education*. London: Cassell; Perkinson, H. (1993) *Teachers Without Goals, Students Without Purposes*. New York: McGraw-Hill. An early, influential contribution was that of Tyrrell Burgess: e.g., *Education After School*. London: Victor Gollancz.

Popper's Theory of Learning

Since my co-presenters have already admirably outlined Popper's theory of learning, I will limit myself to a brief summary[2].

Popper suggested that learning takes place through a process of 'conjectures and refutation', through the testing and modification of expectations about the world (the physical world, the social world, the intellectual world, and so on). According to Popper's view, this process can usefully be understood in terms of 'problem-solving', and he invented a simple, memorable schema to represent this process[3]:

$$P_1 \longrightarrow TS \longrightarrow EE \longrightarrow P_2$$

The learner is faced with a problem (P_1), usually when some expectation is disappointed, and a situation arises for which he is not prepared. In response, the learner throws up a tentative solution (TS), that makes allowance for this new situation. The trial is tested in a process of error-elimination (EE), to see if it is adequate, and as a consequence, a new problem (P_2)arises that is different from the initial problem as it is now in a new situation.

This is, of course, a greatly over-simplified schema, since there are likely to be a multiplicity of solutions and trials. So, a more accurate representation might be:

Popper argued that all life could be understood in terms of this problem-solving schema, that is, all life can be analysed as if it were grappling with problems, from the organism's pursuit of survival and reproduction to the researcher's pursuit of truth (and survival and reproduction!).

Two points need to be stressed before moving on with the discussion. First an important element of Popper's view of learning is that instruction as understood in traditional, inductive models[4] – passive reception of information – does not occur. The learner is not an empty bucket into which information flows; he does not wait passively to pick up information from the outside world, or even have

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[2] For a fuller discussion, see Bailey (2000) *op cit*, Chapter 5.
[3] Popper, K.R. (1972) *Objective Knowledge – an evolutionary approach*. Oxford: Oxford University Press.
[4] Traditional, but still highly influential – see Steven Pinker's recent (2002) book *Blank Slate – the modern denial of human nature.* London: Penguin.

information imposed upon him. Rather, he actively explores his environment, generating trials and testing them against that environment. The only instruction that occurs is initiated by the learner. In Popper's words:

> We learn about our environment not through being instructed by it, but through being challenged by it: our responses (and among them our expectations, or anticipations or conjectures) are evoked by it, and we learn through the elimination of our unsuccessful responses – that is, we learn from our mistakes[5].

Second, the production of solutions is always and necessarily *blind*, in the terminology of Donald Campbell[6]. That is to say, the outcome of solutions, or trials, is unknown when first generated. The learner, no matter how wise or expert, can never know for certain what will come of his solutions. As the psychologist David Perkins put it: 'any genuine problem solving situation calls for answers not yet at hand'[7]. If it is already known that a particular trial will have a certain effect, then it is neither blind nor can anything new be gained as a result of its implementation. This is not to suggest that the generation of trials be random, although it might be. It only maintains that the learner eventually reaches a point where he has no *a priori* basis for knowing which solution will prove most effective, and neither experience nor circumstance will provide sufficient clues about how to restrict or prioritise the range of choices available. Thus, the process is one which solutions or trials are produced blindly and are then tested, either through conscious reflection or practical experimentation.

Learning as a Dynamic System

It seems to me that Popper's theory of learning is a good example of a dynamic system, in which the different elements are inextricably connected to each other through the action of a feedback loop. In its simplest form, learning in a dynamic system is dependent upon feedback: we make decisions that effect the world; we receive information about the world; we revise our understanding of the world and the decisions we make to bring the state of the system closer to our goals[8]. Popper's contribution is, in part, to suggest a logic of this process.

Perhaps the most familiar dynamic system (outside Arkansas and Gateshead) is that of Darwinian organic evolution, which can be summarised in the following statements[9]:

1. Variation occurs spontaneously within any given species;
2. These variations are subject to biological inheritance;

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[5] Popper, K.R. (1994) *The Myth of the Framework*. London: Routledge.
[6] Campbell, D. (1974) Evolutionary epistemology. In P.A. Schlipp (ed), *The Philosophy of Karl Popper*. LaSalle, IL: Open Court: 413-63.
[7] Perkins, D. N. (1998) In the country of the blind: an appreciation of Donald Campbell's vision of creative thought'. *Journal of Creative Behavior*, 32: 177-91.
[8] Sterman, J.D. (1994) Learning in and about complex systems. *System Dynamics Review*, 19 (2-3): 291-330.
[9] cf. Ridley, M.(1993) *Evolution*. Oxford: Blackwell; Simonton, D. K. (1999) *Origins of Genius: Darwinian Perspectives on Creativity*. Oxford: Oxford University Press.

3. Some variations, or traits, are better adapted to the environment than others;
4. The capacity of any species to reproduce outstrips the capacity of the environment to support the potential offspring;
5. Variations that are more fit are more likely to survive and reproduce;
6. With each successive generation, the more fit will gradually replace the less fit variations in a given population.

Or, in its bare bones:
- Genetic variation
- Natural selection
- Reproductive transmission

Darwinism represents a dynamic system because each of element of the process must be understood with regard to the process as a whole:

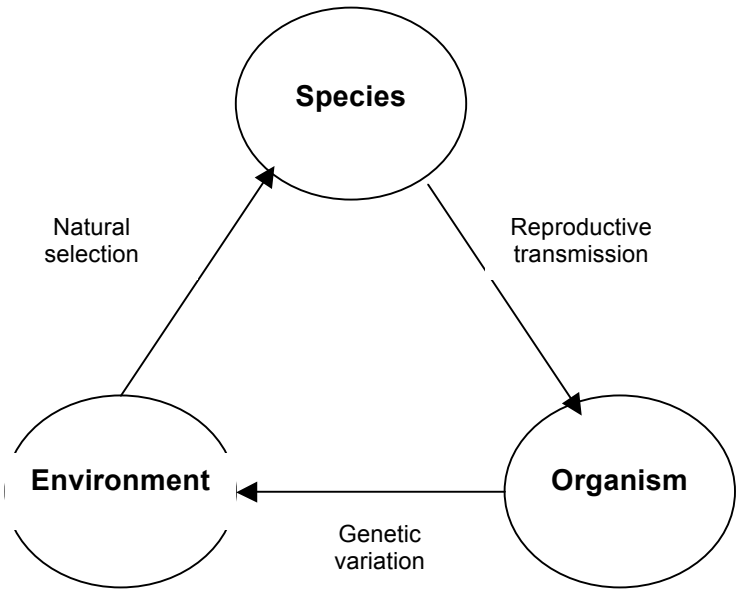

Figure 1: Biological evolution as a dynamic system

According to the Darwinian view, these three sub-processes, over enormous periods of time, lead to the emergence of new species.

Popper suggested that the same logic characterised the emergence of new knowledge. Indeed, it is not a coincidence that his theory of learning, and its parent theory of knowledge should become known as 'evolutionary epistemology'[10]. According to this view human knowledge and cognitive activities are as much products of evolution as a biological species. We come to

[10] Campbell (1974) *op cit*; Radnitzky, G. and Bartley, W.W. (1987) *Evolutionary Epistemology, Rationality and the Sociology of Knowledge*. LaSalle, IL: Open Court; Bailey (2000) *op cit*, Chapter 4.

understand the world through a process of trial and error-elimination, analogous to natural selection in the natural world, through which ideas, theories and thoughts are tested against the environment – whether it be the physical environment necessary for empirical refutation, or the social environment of the relevant social system. These ideas are not 'products' of the individual learner; they are variations of products developed from the culture (or 'World 3', in Popper's later terminology) in which the learner is situated.

This last point deserves further comment, as it might be understood to contradict the earlier point regarding the limits of induction. There is no suggestion here that the learner takes up cultural products in passive way. On the contrary, grasping of cultural information is an essentially active process. Rather than simply absorbing culture, individuals reconstruct it afresh in their minds[11], and it is the active, selective nature of this cultural learning that leads to the variation of ideas that is a necessary element of the dynamic system.

Nevertheless, it does seem to me that Popperian educational scholars have often under-estimated the role of culture in learning[12]. At first look, Popper's problem-solving schema ($\mathbf{P_1} \rightarrow \mathbf{TS} \rightarrow \mathbf{EE} \rightarrow \mathbf{P_2}$) does appear to assume an individualised view of learning: 'a problem occurs when an individual finds that expectations which she or he brings to experience are refuted … by experience, and when the individual desires to resolve the mismatch in some way'[13]. But individuals do not live in intellectual vacuums, and their expectations are not conjured up from thin air. They are a direct consequence of an individual's exploration of the cultural ideas and products that surround them: 'the activity of understanding consists, essentially, in operating with [cultural] objects'[14].

Drawing together the different elements of the discussion – a problem-based theory of learning, the analogy of the growth of knowledge with evolution through natural selection – it is possible to summarise the Popperian approach in terms of a new systems model:

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[11] Popper (1972) *Objective Knowledge*, *op cit.*
[12] See, for example, Swartz, R., Perkinson, H. and Edgerton, S. (1980) *Knowledge and Fallibilism*. New York: NY University Press.
[13] Swann, J. (1998) What doesn't happen in teaching and learning? *Oxford Review of Education*, 24(2): 211-23.
[14] Popper (1972) *Objective Knowledge*, *op cit*: 164.

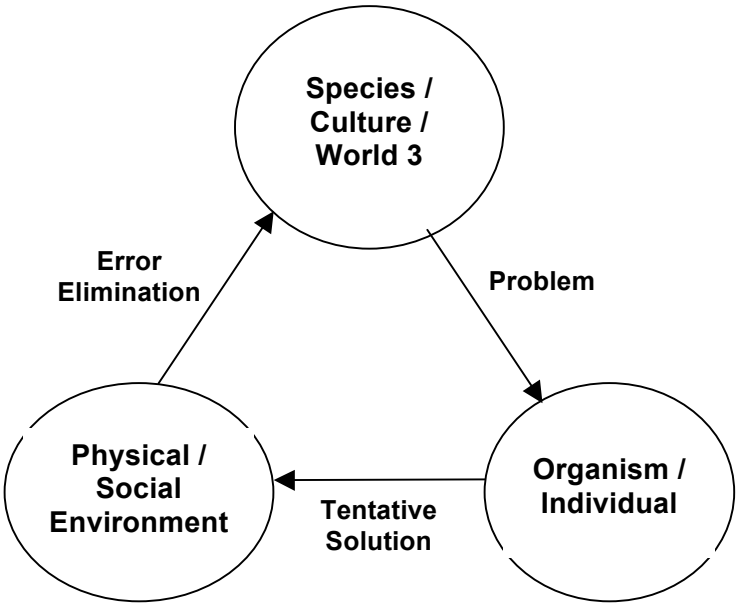

Figure 2: Popper's evolutionary epistemology as a dynamic system

A Systems Approach to Creativity

> A creative act is an instance of learning …a comprehensive learning theory must take into account both insight and creative activity[15].

Research into creativity in recent years has increasingly been informed by systems thinking[16]. That is to say, it has moved away from a conception of creativity purely in terms of subjective activity, to one that recognises the host of factors external to the individual – cultural and environment – that must be taken into account in any adequate explanation of creative ideas and products.

Csikszentmihalyi[17] phrases this changing conception with the question, 'Where is creativity?' An obvious answer will often be, 'In the creative person's head', and this is the position taken by psychologists like Abraham Maslow[18], who argued that it was the process of creating that mattered, not the outcome of that process. However, Whilst the quality of subjective experience is a vital ingredient in a creative act, creativity cannot be assessed solely with reference to it. Rather, in order to be accepted as creative, an idea or product must undergo inter-subjective scrutiny; it must achieve some form of public recognition. This is not

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[15] Guilford, J.P. (1950) Creativity. *American Psychologist*, 5: 444-54.
[16] Csikszentmihalyi, M. and Wolfe, R. (2000) New conceptions and research approaches to creativity: implications of a systems perspective for creativity in education. In K. Heller, F. Mönks, R. Sternberg and R. Subotnik (eds) *International Handbook of Giftedness and Talent – Second Edition*. Oxford: Elsevier.
[17] Csikszentmihalyi, M. (1996) *Creativity: flow and the psychology of discovery and invention*
[18] Maslow, A. (1963) The creative attitude. *The Structuralist*, 3: 4-10.

to deny the importance of individual thought and action, but it does strive to locate this thought or action within their social context.

A second common-sense answer to the question is that creativity is located within the creative object. Herbert Simon[19], for example, once claimed that, because he had devised computer programmes that could replicate the solutions of some of the most creative solutions in science, they should be considered to evidence 'creativity'. The logic of this position dictates that a forger exhibits the same level of creativity as the original artist. But this cannot be correct. Even if a talented mimic is capable of reproducing a painting by, say, Picasso, it would be ridiculous to claim that they would be equal in terms of creativity; technical skill, perhaps. But the creativity of Picasso's work lies, to a considerable degree, in the fact that he introduced novel variations to the art world at a particular point of history. The forger's work is not creative because it simply reproduces existing variations.

Following on from this, the discussion of Popper's evolutionary epistemology would suggest that creativity can be observed in the interrelations of a system made up of:

- Culture
- Environment
- Individual[20]

Operating within a specific cultural framework, an individual makes a tentative solution to an existing problem situation, and if that solution is judged to be valuable by the community, it will be absorbed into culture, thus providing a new cultural framework for the next generation[21]. Thus, creativity is a special case of learning. Just as it makes no sense to say that an act of learning was the result of an individual, alone, without taking into account the cultural and environmental conditions within which the learner is situated, so a creative act or product has to be adapted to its social context.

Several consequences follow from understanding creativity in this way:

- An individual can only be creative in an aspect of cultural to which he has been exposed.

No matter how great the intellectual gifts possessed by an individual, he will not be able to contribute to a cultural domain without learning its language, rules, and symbolic systems. And even if the language of a domain is mastered and new insights are developed, creativity cannot be expressed in the absence of a social environment that recognises and legitimises the contribution.

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[19] Simon, H. A. (1988) Creativity and motivation. *New Ideas in Psychology*, 6(2): 177-81.

[20] Csikszentmihalyi (1996) *Creativity*, *op cit*, offers a similar model, but uses the terms 'domain' (for culture), 'field' (environment) and 'person'. The process, however, is essentially the same, and I have drawn upon his analysis a great deal in the following sections.

[21] Csikszentmihalyi, M. (1988) Society, culture and person: a systems view of creativity. In R. Sternberg (ed), *The Nature of Creativity: contemporary psychological perspectives*. Cambridge: Cambridge University Press.

- A broad cultural learning facilitates creativity.

Individuals with a broad range of intellectual interests are more likely to encounter concepts in different contexts, and thereby identify possible associations and links, and, within the context of a specific area of enquiry, innovation: 'the history of great creative ideas is replete with examples of people finding a solution to a major problem in one domain while engaging in "recreational reading" in an entirely different domain" [22]. For example, it was whilst reading Malthus' *Population* 'for amusement', that Darwin came to realise the significance of differential reproduction to organic evolution[23].

- New ideas are not recognised or adopted by a culture unless they are endorsed by its 'gatekeepers'.

Cultures are conservative, and for good reason, as it would be impossible to assimilate all novel ideas and practices without undermining the very coherence of the culture. There must be some shared values, and because of this, it is necessary to be selective. Selection is rarely made by society, as a whole. Rather, that responsibility is usually handed to (or taken by) a group of 'experts', who act as a filter, who help decide which ideas to pay attention to, and which to ignore. In the field of art, for example, gatekeepers might include:

- Art teachers and historians, who pass on the symbolic information to the next generation;
- Art critics, who establish the reputation of individuals artists;
- Collectors, who make it possible for artists and works of art to survive;
- Gallery owners and museum curators, who preserve art products; and
- The peer group of artists, whose evaluations define styles and revolutions of style[24]

Einstein's reputation as a creative genius is a good case in point from the field of science, since the acknowledgement of his contribution was certified by a very small group academics, and was duly accepted across the world, despite the evident fact that hardly anyone had any idea what his theories were about.

A corollary of this point is that it is beholden on a creative person to convince the gatekeepers that he has made a valuable innovation.

For, 'if you cannot persuade the world that you have had a creative idea, how do you know that you actually had it'[25]? This is a point endorsed by the Nobel Prize-winning economist, George Stigler:

> I have always looked upon the task of a scientist as bearing the responsibility for persuading his contemporaries of the cogency and validity of his thinking. He isn't entitled to a warm reception. He has to earn it, whether by the skill of his exposition, the novelty of his ideas, and what. I've written on subjects which I thought had promise which haven't amounted to much. That's all right. That may well mean that my

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[22] Simonton (1999) *The Origins of Genius*, *op cit*: 90.
[23] Darwin, C. (1892) *The autobiography of Charles Darwin and selected letters* (Edited by F. Darwin). New York: Dover : 2-3.
[24] Csikszentmihalyi (1988) Society, culture and person, *op cit*
[25] Csikszentmihalyi and Wolfe (2000) New conceptions *op cit*: 83.

> judgement wasn't good, because I don't think any one person's judgment is as good as that of a collection of his better colleagues[26].

- Creative individuals are problem-finders[27] as well as problem-solvers.

Popper conceptualised all learning in terms of problem-solving, but, it may be that the finding and formulating of problems is at least as important. As Einstein put it:

> The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new problems, to regard old problems from a new angle, requires creative imagination and marks real advances in science[28].

Creative insight often occurs when individuals question the obvious, or sense problems which have been overlooked by others.

- Creative people have the ability and motivation to create multiple tentative solutions.

An essential component of Popper's theory of learning is the production of solutions to production, and, as was made clear earlier, it is often the case that individuals produce numerous potential solutions to a single problem. In fact, Popper's rejection of induction in learning, and consequently our 'blindness' when facing any learning situation, means suggests that the production of a wide range of ideas is more likely to be fruitful than the pursuit of a single solution.

There is considerable empirical evidence showing that creative people are often characterised by the great variation of their outputs, as much as their quality. Darwin, again, is a good case. Despite severe ill-health, he was able to produce over a hundred publications, on a range of topics: geology, zoology, botany, ecology and psychology. Even when Darwin's theory of evolution through natural selection suffered a period of neglect in the early part of the twentieth century, he was still recognised as a genius for his contribution to other scientific fields.[29] Moreover, research consistently shows that the best predictor of creative reputation among both contemporaries and future generations is the total lifetime productivity[30].

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[26] Interviewed in Csikszentmihalyi (1996) *Creativity*, *op cit*: 42-43.
[27] Jay, E.S. and Perkins, D.N. (1997) Problem-finding: the search for mechanism. In M.A. Runco (ed) *The creativity research handbook* (Volume 1). Cresskill, NJ: Hampton Press.
[28] Einstein, A. and Infeld, L. (1938) *The evolution of physics: the growth of ideas form early concepts to relativity and quanta*. New York: Simon and Schuster: 95.
[29] Simonton, (1999) *The Origins of Genius*, *op cit.*
[30] See, for example, Simonton, (1999) *The Origins of Genius*, *op cit.*; Feist, G.J. (1993) A structural model of scientific eminence. *Psychological Science*, 4: 366-71; Simonton, D.K. (1991) Emergence and realisation of genius: the lives and works of 120 classical composers. *Journal of Personality and Social Psychology*, 61: 829-40.

Elements of a Creative Education

So, what of education? It seems clear from the previous discussions that education is a central influence on the development of creativity – both positively and negatively.

Schools can be seen as consisting of the same three elements of the dynamic system[31]:

- a **curriculum** to be transmitted to the next generation;
- a **school system** that controls the curriculum; and
- a group of **students**, whose task it is to learn the curriculum.

The relationship of these elements can be readily accommodated within the system model presented above:

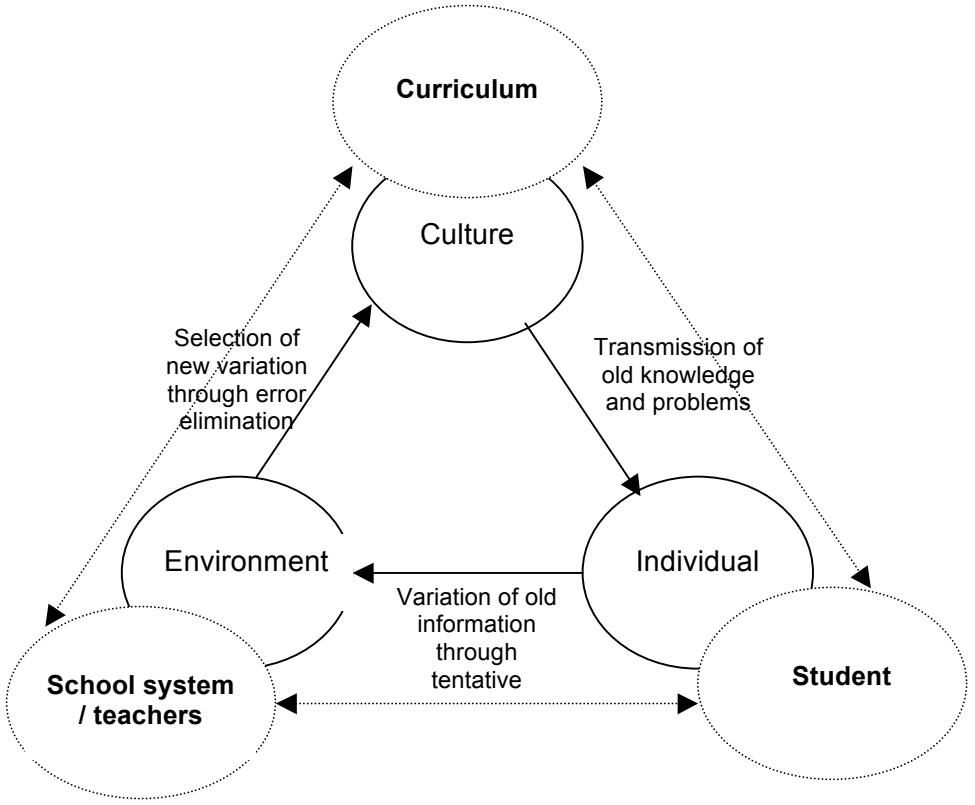

Figure 3: A systems view of schooling and creativity

However, a tension becomes immediately apparent: the school's role as a transmitter of knowledge can be inimical to the creative process, which aims for innovation and the revision of knowledge.

[31] Csikszentmihalyi and Wolfe (2000) New conceptions *op cit*: 83.

It is not simply a matter of schools abandoning their role of passing on knowledge, and concerning themselves wholeheartedly with the facilitation of innovation, since the system depends upon the transmission of reasonably accurate information without losing much of the hard-earned knowledge of previous generations, which acts as the raw material from which variation emerges[32].

In practice, good teachers have always encouraged and fostered original thinking in their students. Whilst it is extremely unlikely that school pupils or undergraduates will introduce an innovation that carries over into the wider cultural, the very act of trying to innovate and challenge the established practices suggests an engagement with learning and the curriculum that ought to be encouraged. Moreover, activity of this sort can form the foundations of later creativity, once the individual has mastered the curriculum to a point where he can make a genuine contribution.

One possible resolution of the tension between curriculum and creativity is provided by Popper. He distinguished between two levels of 'tradition': the first level is concerned with the accurate transmission of knowledge; the second level focuses on fostering the creative or critical approach to the first level[33].

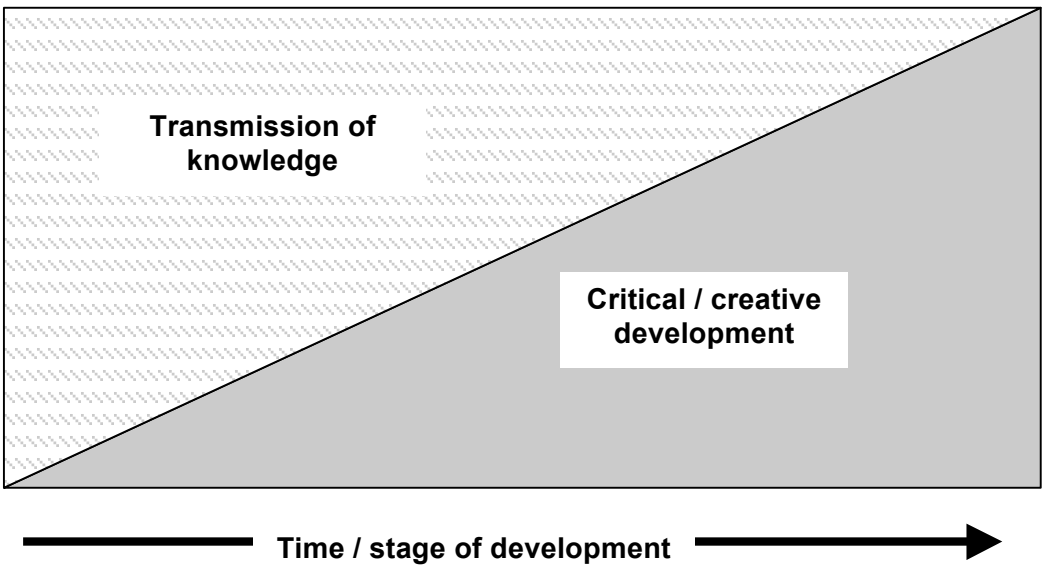

Figure 4: Popper's 'dual tradition' of schooling[34]

[32] Csikszentmihalyi and Wolfe (2000) New conceptions *op cit*:
[33] Popper, K.R. (1975) Contribution. In H.A. Krebs and J.H. Shelley (eds) *The creative process in science and medicine*. Amsterdam: Excerpta Medica.
[34] Bailey (2000) *Education in the Open Society*, *op cit*.

He suggested that the two traditions should be taught simultaneously, but that the degree of critical involvement with the curriculum would necessarily increase as the student developed a firm grasp on the material:

> Up to a certain stage, the teacher has to be quite dogmatic, with many things … Any critical attitude, and any non-dogmatic attitude, assumes a certain evolution of a stage in the child. And one of the interesting tasks of the teacher is to find how far this particular child is capable of being taught[35].

Conclusion

This paper has considered a possible extension of Popperian theory, in which learning is understood to result from the action of a dynamic system. Using this approach to explore creativity, it has been suggested that an adequate understanding can only be reached when we recognise the interaction of a range of factors external to the individual – cultural and environment – that must be taken into account in any adequate explanation of creative ideas and products. Since cultural rules and social systems are prerequisites of the creation and recognition of innovation, schools and teachers play a vital role. In fact, if the argument offered here are valid, it may be that we have spent far too much time searching for 'gifted' students, whose talents we can enrich and accelerate. Perhaps we need to think rather more about the roles that schools and teachers, as the main transmitters of knowledge and gatekeepers of creativity, play.

To conclude, Jerry Springer style, I offer a 'final thought':
A famous jazz trumpeter, I think it was Fats Domino, was once interviewed by a journalist, who noted that he had never had formal instruction in music. The interviewer asked, 'Do you think that a teacher would have restricted your creativity?' The jazzman replied, 'No, not a good one'.

[35] Personal communication.