

Contemporary Themes in the Research Enterprise

Tony Gibbons

Flinders University tony.gibbons@flinders.edu.au

Gavin Sanderson

Flinders University gavin.sanderson@flinders.edu.au

This paper discusses themes associated with the enterprise of educational research, particularly as it applies to notions of ontology and epistemology in 'quantitative' and 'qualitative' methodologies. It begins by identifying the 'space' that educational research occupies in the contemporary social setting and indicates the growing complexities of the 'real world' which researchers contemplate. The development of empirical and interpretive methodologies is traced through an historical analysis of educational research which highlights the emergence of the postmodern platform. This leads to an examination of the traditions of both the 'quantitative' and 'qualitative' approaches with a view to understanding their positioning in the field of educational research. It is maintained that these two methodologies are examples of paradigms which exist within traditions. They are often said to be incommensurable paradigms. We propose a solution to their seeming incommensurability which in part involves assessing the coherence of the idea of a 'paradigm'.

Research, Qualitative, Quantitative, Paradigm, Tradition

INTRODUCTION

Oh East is East, and West is West, and never the Twain shall meet
Till Earth and Sky stand presently at God's great judgement seat
But there is neither East nor West, Border no Breed, nor Birth
When two strong men stand face to face, though they come from the Ends of the Earth¹

The opening stanza of Kipling's work 'The Ballad of East and West' provides a paradox that sets the scene for this paper. Initially, the poem describes two camps that are seemingly eternally separate and anathema to one another. In the absence of any commonality, a schism separates them. Later, this 'difference' is cast aside and is replaced by a perception of 'sameness' when social and historical identifiers are stripped away by the process of peoples from the East and West coming to face each other. Their shared humanity unites them (despite the inference of a lingering propensity for hostility). We are left feeling that East and West can be simultaneously different *and* the same, depending upon the perspective of the observer. So, too, can this analogy be extended to the enterprise of educational research.

¹ Poet's Corner (2001) Rudyard Kipling, *The Ballad of East and West*. Available on-line: <http://www.geocities.com/~spanoudi/poems/kiplin01.html> [2002, 28 August]. The poem is used as a vehicle to introduce the theme of the paper. 'East-West' should not be interpreted as suggesting 'global coverage' in the sense that there are no methodologies other than those which are either 'qualitative' or 'quantitative'.

On one hand, there is talk of a great divide separating 'quantitative' and 'qualitative' research, based on the existence of two perspectives on the study of human behaviour. This has profound implications for how educational research is conducted (Burns 1990, p. 1). It has been argued that proponents of the 'P-Theory', or the idea that we are dealing with two different research paradigms come in two classes. There are those who subscribe to the '*oppositional diversity thesis*' and maintain that the two paradigms are epistemologically different and incommensurable. Others are sympathetic to a '*complementary diversity thesis*', which suggests that whilst they may be epistemologically distinct (and incommensurable), they overlap in their different approaches to enquiry and are complementary, not competitive. A position against the P-Theory, the '*unity thesis*', denies that there is fundamental diversity in educational research and that a commonality of purpose means that there is no sound epistemological basis for having separate research 'paradigms' (Walker and Evers 1997, p.22). This paper is critical of the idea that paradigms are incommensurable and takes issue with the notion that quantitative and qualitative research are best described as paradigms. In our view they are traditions, which contain a number of paradigms. In fact Walker and Evers talk of them as traditions and confuse the issue of the distinction between traditions and paradigms. It is our view that the two traditions, while distinct, can and should be brought together in educational research (Keeves 1997, p.7)

For all researchers, it is important to have some understanding of the issues raised here, if only to better understand how their research activities may be justified. At the moment there is confusion in educational research engendered by the different approaches. Staff and students alike have been known to hoist a methodological flag over their research territory and defend it with vigour against claims that their particular way of conducting investigations is inappropriate, lacking in rigour, and 'not proper' research. This paper argues that most of the hubbub is less to do with enlightened dialectic, and more a case of a lack of familiarity with, and understanding of, the philosophical issues underwriting the divisions so often encountered between the so-called 'research paradigms'. Discussions of differences, if it is to be valid and constructive, must appeal to ontological and epistemological considerations; not a dismissive attack on those who support or eschew 'quantitative' over 'qualitative' and vice versa. The discussion in this paper goes beyond the theses expounded by Walker and Evers and suggests that although quantitative and qualitative approaches have their own strengths and limitations, they can be said to be as incoherent as each other when it comes to helping form universal generalisations about the 'real world'.

THE CONTEMPORARY SETTING

Initially, it is crucial to recognise the complicated milieu in which contemporary educational research takes place, for it would appear that the complexities associated with 'what and who are researched' have accelerated in an exponential-like manner in the past few decades. As civilisations across the globe enter the third millennium, never before has the planet been host to such a large and increasingly mobile human population. The population is presently climbing through six billion, having doubled in the last fifty years, and it is expected to pass nine billion by the middle of this century (US Census Bureau 2002). Never before has technology been so advanced and intertwined into the daily lives of so many people. The amount of information that most individuals can access and assimilate on a daily basis is unprecedented. Never before has human activity been able to so markedly leave an imprint made distinctive by its ubiquity and the way in which it both dominates and degrades the physical environment which sustains us. There are real questions about whether we can

survive as a species, given the damage that we are causing the Earth through overpopulation and a rapacious *growth-as-development* mentality. Never before has humanity been so materially rich, yet so poor, with a minority of the world's population controlling the majority of its wealth. Whilst some may argue that global inequality in personal incomes has fallen in real terms since 1975 (Bradford-DeLong 2001), it is clear that the domination of the world's resources by the developed countries continues to perpetuate major inequalities. In summary, "after a century of the greatest flowering of human knowledge, there are more poor, more knowledge-deprived, more suffering, more unsustainable development, more sick and dying than ever before" (Cribb 2002, p. 29).

To paraphrase Charles Dickens, today we are simultaneously witnessing the best of times and the worst of times! This is the landscape, which the enterprise of educational research presently contemplates, and, to extend the challenge, the changes in the next one hundred years are likely to exceed those of the last one thousand years in terms of impact, speed, scope and importance (Beare & Slaughter 1995, p. 5). This is likely to have significant import not only for the foci of research activities in the immediate future, but also for the *activity of research* in the 21st century, itself a contested terrain underwritten by a milieu which has inherited an economic, political and epistemological 'zeitgeist' from the last decade which was "considerably less certain and confident than it had been some thirty years previously" (Welch 1999, p. 35).

THE RESEARCH ENTERPRISE IN THE CONTEMPORARY SETTING

By the late 1990s, a plethora of approaches characterised the contemporary research enterprise (see Table 1). Keeves (1997) acknowledges the diversity by stating that;

"...there is now a greatly increased variety in the strategies and tactics employed in research into educational problems, as well as in the methods, theoretical perspectives and analytical procedures that are being used to investigate the processes and practices, the context and conditions, and the products and policies which occur in the field of education" (p. xv).

Carspecken (1996) concurs by musing that a room filled with social researchers would be a cacophony of cliques, with each exhorting their own distinctive jargon and cultural style (p. 1). Such is the growing diversity and complexity in approaches; an indication that "the frontiers of educational research are constantly changing" (de Landsheere 1997, p. 15).

The enterprise of current educational research includes the largely scientific, or quantitative, approach² that is derived from natural science and was *de rigueur* throughout most of the 1900s, as well as the newer perspectives and methods offered by humanistic, or qualitative³, researchers since the early 1970s. Both methodologies seek to make contributions to the 'body of knowledge' that allows us to use generalisations to benefit educational and social practices (Keeves 1997, p. 3; Arnove & Torres 1999, pp. 4-6). In addition to these two well-known positions, others have emerged which examine the workings of our societies, particularly in terms of relations of power and its consequences and clearly have their origins in Nietzsche. These are 'critical theory' or 'critical action research' which is directed at social change (Keeves 1997, p. 6), and the 'postmodern' approach, sometimes called 'poststructural' or 'deconstructive', which is a method of discourse analysis that analyses knowledge in terms of "who speaks, for whom and by what authority" (Smith 2000, p. 10). Both of these latter approaches are aimed at the politics of emancipation and social justice and resonate more with qualitative approaches than quantitative ones.

² Also referred to as scientific, positivist, empirical, logical empiricism, or objectivist approaches.

³ Also referred to as interpretive or subjectivist approaches.

Table 1: Approaches to Enquiry⁴

Quantitative	Qualitative	Criticalist	Deconstructive / Poststructuralist
Approach			
Classical physical sciences investigation	Historical & existential studies valuing subjective understanding of subjects	Marxist, interpretive & psychoanalytic studies which focus on insights & judgements of subjects	Anthropological, psychoanalytic & linguistic understanding of the interrelationships between culture, language, desire & the self. Understands the self/subjectivity as decentred and in process
Assumptions about reality			
Reality is unitary & only understood by empirical analytic enquiry	Multiple realities exist & require multiple methods to understand them	Multiple realities made problematic by distorted communication	No reality or 'real world' accessible beyond language. Reality constituted in & through discourse. Constituted by language & naturalised through ideology
Foundation of data			
Disciplined, rule-governed sensory-perceptual observation, i.e. rules for observation	Meaning is the basis for data & precedes logic & fact	Meanings found in language & social behaviour & precedes logic & fact	In language understood as discourse or a system of meaning. No fixed meaning because it shifts according to context & motivations of speakers & writers and listeners & readers
Observation			
Via clear & unambiguous rules, not modified by the setting and independent from it	Through social, linguistic & cognitive skills of researchers, i.e. dialogue	Interpretive methods & critical self-reflection concerning grounds of observation	Interrogating various discourses which constitute the field of enquiry & analysing power relationships generated through discourses
Outcomes of enquiry			
Evidence and generalisable laws not affected by context or the investigative methods. Objectivity removes error & bias	Knowledge that is dependent on the process of discovery. Integrity of findings based on quality of social, linguistic & cognitive skills of the researcher in data collection, analyses & conclusions	Knowledge which falls within the interpretive framework but also assists personal liberation & understanding & emancipation from forces constraining rational independence of individuals	How knowledge is constructed. Questions foundations & frame-work of knowledge. Asks how knowledge has been constructed as truth and how social realities are constructed through language
Inherent interests			
Prediction & control, technically exploitable knowledge. Explanation	Discovering meanings and beliefs underlying actions of others. Understanding at the level of ordinary language & action	Interpretive interests plus revealing interests underlying other forms of enquiry & action. Improving human existence. Practical outcomes for the public good	Questions totalising or unified interpretations & understandings. Views them as partial. Seeks to locate dominant interest & modes of producing & maintaining them. What positions are possible for marginalised groups
Inherent values			
Science & scientific knowledge are inherently value-neutral	Science & scientific knowledge must be interpreted in terms of the values they represent	Science & knowledge are never value-neutral. They always represent certain interests	Scientific truths & knowledge are never value-neutral; they are the effects of power. 'Value' is a contested terrain because of (i) inherent contradictions between the researcher & the researched, and (ii) contrary values within oneself due to ideologies of gender, race, age, ethnicity, class sexual preference, nationality, etc

Initially then, the challenge for the researcher would appear to be where to locate themselves in terms of a specific approach to their research and, more often than not, this is probably done by what they know in terms of their training as well as following the lead of their associates, peers, colleagues, and 'experts' in the field (Paul & Marfo 2001, p. 527). Siding with a particular methodology because it is favoured by a certain group of scholars, a funding body, the government, or wider society is understandable if not always justifiable.

⁴ Adapted from Connolle (2000), pp. 32-33.

The starting point for any researcher should be for them to take time to reflect on the world that they know and ask “*of the things that I believe, why do I see them as such and what is the philosophical framework that makes it so?*”. Honesty is not simply a social virtue but an intellectual virtue that demands that the researcher inspect their personal ontological and epistemological framework and see it in the context of their history in the society of which they are a part. This society is not simply the broad society in which they live but the community of researchers of which they are a part. This task is not easy and participation requires a judicious mix of openness, detachment, honesty, and logic, underwritten by a self-referential consistency and a willingness to step outside what is acceptable, even fashionable, and perhaps expected. In other words, the intellectual virtues. Therein lies the basic challenge and one that individuals and educational institutions must address in terms of “the professional preparation of educational researchers” (Paul & Marfo 2001, p. 534).

BACKGROUND TO THE RESEARCH ENTERPRISE

de Landsheere (1997) provides an historical account of educational research which looks at developments in distinct periods over the past 120 years and it is useful to consider the chronological account he outlines to better understand the evolution of educational research and its main characteristics (pp. 8-16):

pre-1900: Characterised by ‘experimental psychology’ in Europe and the United States that was concerned with children’s language and imagination. The beginning of the ‘child study’ movement.

1900-1930s: A ‘heyday of empiricism’ which focused on rational management of instruction and saw the development of descriptive and inferential statistics.

1930s – 1950s: A loss of impetus in the strict scientific approach, due to philosophy taking precedence over science by valuing life experience over experimentation.

1960s - 1970s: A ‘knowledge explosion’ due to technological advances and the ability of affluent societies to fund research activities at unprecedented levels. Also, the beginnings of an epistemological debate in the social sciences, underwritten by the belief that rigid science could not accommodate the many perspectives of human behaviour and the subtleties of the social setting.

1980s - 1990s: An acknowledgement that no one research paradigm can claim hegemony in educational research and a softening of the hardline distinction between ‘quantitative’ and ‘qualitative’ methods. Also, recognition that no one research method can provide knowledge of the *true nature of phenomena*.

Despite the above indicating periods in which other ways of looking at the world achieved some prominence, much of the research enterprise in the twentieth century was dominated by a faith in broadly technocratic social science concepts of modernity, drawn largely from a functionalism⁵ which had its origins in the French Enlightenment and perhaps as early as the birth of modern science in the seventeenth century. As Welch (1999) argues, however, the past few decades have seen a ‘collapse of certainty’ with regard to this theoretical way of seeing the world. It has been “breaking up, revealing an increasing fragmentation of purpose, and perhaps failure of vision” (pp. 25-26).

⁵ Sometimes also called ‘structural functionalism’.

Tracing the Fragmentation of the Research Enterprise and the ‘Collapse of Certainty’

To describe the main characteristics of the present traditions of quantitative and qualitative approaches to research is, necessarily, to give an account of its history. That history should reveal not merely the characteristics but also the origins of the divide and the flaws in each approach. Given the progress that the natural sciences made throughout the nineteenth century, it is not surprising that the framework of the social sciences which began to emerge around that time was influenced by, and consequently shaped on, scientific models. For example, Comte’s ‘sociology’ and John Stuart Mill’s ‘experimental psychology’ inherited strongly the idea of ‘functionalism’ that was derived from the methods of the natural sciences, in particular physics. Herein, too, lay the origins of modern educational research (de Landsheere 1997, p. 9; Husén 1997, p. 17; Welch 1999, p. 28). Applied to education, functionalism describes the role of scientific reason, where the use of a supposedly value-free social science would allow researchers to simply seek out and present the facts, avoiding questions of ethics or any moral dimensions of knowledge they advanced. One can see how this approach would have seemed desirable to civic and political leaders of the time in terms of giving a developing society a precise method by which it could pursue its social-cum-national goals. It was an opportunity to deliver a precise future by means of positivistic investigations through scientific methodology, which had the capacity to herald in the same golden age of progress, and discovery that was the hallmark of natural sciences at the time (Welch 1999, pp. 27-28).

As de Landsheere reports, the first few decades in the 1900s were giddy days of empiricism, where educational research, armed with a framework which was steeped in the tradition of the natural sciences, focused on rational management of instruction and advanced the development of new curricula, psychological testing, administrative surveys, and normative achievement surveys. In addition, researchers were managing their data with the already established methods of descriptive statistics, as well as using the inferential statistical concepts that developed throughout the 1920s and 1930s (p. 8). In our view the use of the term natural sciences conceals the overriding importance attached to the methodology of physics and, in particular, classical mechanics.

The period from the 1930s to the late 1950s gave us perhaps the first indications of a social environment, which would lead to questioning the suitability of natural science’s framework of subject-object dualism for research into the human condition. The catalyst for this was a compounding of the Western economic crisis of 1930s and the impact of World War II on countries across the globe. The 1929 U.S. Stock Market crash brought about a massive economic slump that spread to virtually the entire industrialised world and lasted for a decade. Understandably, research funds became very scarce. Then, in 1939, the world descended into World War II; the most bloody conflagration in human history. Whilst educational research continued in some countries, it more or less ground to a halt in others, either as a result of a redirection of focus on the war effort or, in the case of Germany and Russia, because “freedom of research was not acceptable to dictators” (de Landsheere 1997, p. 13). Despite a continued interest in educational research based on natural science, de Landsheere reports that two factors in addition to the world economic crisis and WWII led to the strict scientific approach losing some impetus to a more philosophically oriented and innovative progressivism, (a) the atomistic character of most educational research, and (b) the appeal of combining empirical research with social and political philosophy, which merged free enterprise and a liberal spirit with humanistic socialism (p. 8).

Of interest, the emergence of ‘critical theory’, or neo-Marxism, in this period is linked to a number of scholars in Germany who not only recognised the injustices and social distortions that could be perpetrated by political regimes (themselves having had first-hand experience with this under Hitler), but also rejected the all-pervading influence of positivism which championed ‘instrumental rationality’ and viewed all practical problems as technical issues (Bosetti et al 1989, p. 3). The ‘Frankfurt School’ held that the popular appeal to ‘scientism’ created an illusion of an ‘objective reality’ over which the individual has no control, and hence a diminished capacity to reflect on and change their own situation. By advocating the Weberian principle that *ends, means, values and facts* are conceptually separable, the scholars maintained that scientism led to a *bureaucratic rationality* which promoted a *false consciousness* whereby the prevailing social mechanisms bind some groups to accept irrational and distorted ideas about their social reality (Carr & Kemmis 1986, pp. 96-130; Rizvi 1986, p. 3).

The economic and technological developments in the period after World War II culminated with an explosion of knowledge by the 1960s and 1970s, fuelled by the availability of fiscal and technical (including computer) resources. The dynamism of the post-war era was palpable and educational research, particularly in the United States, was funded at unprecedented levels by the public and private sectors (de Landsheere 1997, p. 8, 13-14). It is ironic that this apparent time of plenty also crystallised the challenges to natural science as the best way to conduct research into human activity and behaviour. As Keeves (1997) reports, the increased funding for educational research provided scholars in the social sciences with opportunities to work collaboratively on education issues with historians and philosophers (p. 4). Whilst this was important in introducing new perspectives and methods into fields such as sociology, anthropology, politics, history, and philosophy, what was happening in broader society was paving the way for what Welch (1999) calls ‘fin de siècle fractures’ of a rationalist ideology of perfectibility (p. 35).

By the late 1960s, there was a perception of a ‘cultural crisis’ in industrialised societies which was derived from a disappointment that neither science and technology, nor middle-class values, were solving problems in the sense of providing general peace, wealth, and happiness (de Landsheere 1997, pp. 13-14). More concrete examples are provided by Welch (1999):

“The oil crisis of the 1970s, as well as periods of intermittent recession thereafter, led to the advent of mass unemployment, especially among the young ... The widening gap between rich and poor (both within and among countries) and the increasing deregulation of many economies evidenced a more general decline in government activity and intervention in social and economic affairs. In the social sciences, the confident certitudes of earlier decades were falling increasingly into disarray.” (p. 35)

This despair of this period reflected a time when not only was the nature and use of scientific method questioned in the social sciences, but so were the foundations of science itself. According to Burns (1999), “Science ... lost its aura of eliteness and sacredness, which in the past has prevented researchers from questioning its assumptions” (p. 12). The technology and knowledge that had promised so much for humanity, looked unable to solve the profound social and environmental problems arising out of our emerging modernity. Herein lies the seed for what would become the ‘poststructuralist’ thinking which would reject much of the modernist platform by challenging the assumption that the dictates of technology of reason would promote a more rational and more morally perfect world (Welch 1999, pp. 28-35). It should be said that it was not so much an attack on the *idea of science* per se; rather, it was a call for science to be accountable in terms of the logic of its methodology, its knowledge claims, and its apparent detachment from questions associated with value, ethics, and politics (Connole 2000, p. 18).

This is an account of one view of the collapse of scientific certainty. From the view of the theoretical physicist the collapse had occurred much earlier. In 1795 Karl Friedrich Gauss entered the university of Göttingen having already devised the gaussian curve. With that curve came the realisation that the error can never be taken out of observations. The achievement of twentieth century physics was to show emphatically that Gauss was right and there is no such thing as an exact picture of the world of our reality. In 1927 Heisenberg stated his principle of uncertainty and that uncertainty is mapped out by Planck's quantum (Bronowski 1973). It took some time for educational researchers to realise what had happened. The view of physics on which they had based their view of scientific research in education was passé. Society at large still does not appear to have grasped the idea.

There emerged two ways to research educational problems which Husén (1997) describes as separate approaches that are either 'functional-structural, objective-rational, goal-directed, manipulative, hierarchical, and technocratic' or 'interpretivist, humanistic, consensual, subjective, and collegial' (p. 19)⁶. Overall, it is fair to say that there has been a great deal of tension between the various methodologies to the point where the investigation of educational problems has suffered as a consequence, through schools of education being split, editorial policy of journals being influenced by research approaches, preferential funding for certain projects, and administrators and politicians belittling research in education (Keeves 1997, p. 1).

THE TRADITION OF THE QUANTITATIVE APPROACH

Quantitative approaches to research are often termed 'empirical'. Empiricism, however, is not a methodology as such but a thesis that knowledge is gained by observation of real events. As far back as Ancient Greece, scholars began to base important conclusions about nature on their observations at the expense of more widely held non-empirical conceptions such as mythology, religion, and appeals to authority. Indeed, many great advances in science facilitated by people such as Hippocrates, Copernicus, Galileo and Darwin are attributed to empiricism as a way of gaining knowledge (Graziano & Raulin 1996, p. 8). An empiricist believes that reality is unitary and it can be understood by empirical analytic enquiry, a method which collects data verified by the senses to form or test a theory (Connole 2000, p. 32; Doordan 2000, p. 57). With regard to social reality, the quantitative approach is *nomothetic* in assuming that it is objective and external to the individual (Burns 1999, p. 3).

Proponents of a quantitative research claim to use a 'scientific method' which has the characteristics of *control*, *operational definition*, *replication*, and *hypothesis testing* (Burns 1999, pp. 5-7). They would argue that their approach provides advantages such as;

1. Distancing the researcher from the object of enquiry in the sense that the enquirer is independent from those being researched. As such, the findings should not be influenced by the researcher (Doordan 1998, p. 140);
2. Demanding that the description of phenomena involves precise, unbiased recording of observations. There is an emphasis, therefore, on a research design which is based on measured, quantitative information which can be analysed by statistics to support or disprove claims;

⁶ This paper considers the 'quantitative/qualitative' divide. It recognises the existence of 'critical theory' and 'postmodern / deconstructive' approaches, but collapses them into the qualitative framework for the purpose of the argument.

3. Eschewing relativist and metaphysical claims as well as seeking objectivity by removal of errors, values and biases (Connole 2000, p. 41; Doordan 1998, p. 140);
4. Maintaining an emphasis on replication, prediction and control, and
5. Being based on *philosophical determinism* which is the notion that events occur according to regular laws and, as such, human behaviour can be viewed as an outcome of antecedent environmental events (Connole 2000, p. 41).

At this stage it should be made clear that empirical or positivist investigations can occupy a variety of positions, ranging from ‘hard empiricism’ or logical positivism (which asserts that the scientific method is the *only way* to test knowledge claims) to ‘soft empiricism’ (which lends itself to empiricist and non-empiricist methods) (Connole 2000, p. 40).

THE TRADITION OF THE QUALITATIVE APPROACH

Interpretivists (or internalists) maintain that we use constructs such as culture, social context and language to build our view of the world and that social reality is shaped through social interactions (Smith 1989, p. 74). Implicit in the interpretivist notion of existence is *intentionality* which refers to a state of ‘being in the world’ and infers an interdependence between ‘thought’ and ‘lived experience’, predicated on ‘meaning’ derived from ‘social interactions’ (Smith 2000, pp. 97-98). Because existence is viewed in this way, interpretivists are committed to an epistemology which embraces *social constructivism* and knowledge as ‘meaning in context’ made possible by social interaction (Williamson 2000, p. 30). Social knowledge is not, as empiricists (or externalists) claim, something which exists independently or external to us and waiting to be discovered by untainted sensory perception. Interpretivists say that you cannot have unmediated access to reality. Instead, they see the world as mind-dependent. As such, it appeals to philosophical notions of relativism, existentialism, and phenomenology.

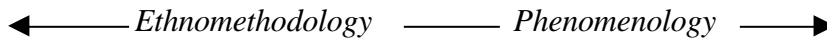
Given these interpretivist tenets, it follows that their research interests will be concerned with people’s beliefs, feelings and interpretations and how they make sense of their world through meaning (Williamson 2000, p. 31). The roots of this form of enquiry lie in *hermeneutics* which originally referred to the interpretation and understanding of scriptural texts. Gradually the term has come to be used in a wider context to include human actions, customs and social practices (Williamson 2000, p. 141). Interpretivism is an umbrella term normally associated with qualitative research methods⁷ for evaluation in the social sciences. The research is field-focussed and natural settings are the direct source of data in which the researcher is the key instrument. The researchers are concerned with process rather than simply outcomes and the research is *idiographic* in the sense that it studies individual cases (or small groups) intensely. The data is descriptive, *thick, and rich*⁸ and has traditionally been collected by means of words and pictures rather than numbers. Furthermore, data collection and analysis occur simultaneously and theories are developed inductively from the ‘bottom up’ by means of the evidence which is collected (Smith 2000, pp. 101-105; Bogdan & Knopp Biklen 1992, pp. 29-32). de Landsheere (1997) acknowledges a diversity of approaches employed by the humanistic research movement, e.g. anthropology, sociology, politics, history, linguistics, philosophy, and ethnomethodology (pp. 8 & 13). Moreover,

⁷ It should be noted that some interpretivist approaches (e.g. *grounded theory*) do use quantitative techniques. In addition, we assert that there are qualitative approaches that lie outside of the ‘interpretive umbrella’.

⁸ Data which goes beyond fact and surface appearance by presenting detail, context, emotion, feeling, spatial and temporal character, voice, meaning and interrelationships (Smith 2000, p. 198).

interpretive approaches can be generally classified by their purpose, orientation and report form⁹(Smith 2000, p. 118):

Interpretive orientation	Explanatory	Descriptive	Expressive
Report form	Presentational	Explication of issues	Representational
Research purpose	Theory generation	Portraying complexity	Eliciting ethical reasoning
Research methodologies	Grounded theory	Qualitative case study	Narrative enquiry



THE POSITIONING OF EDUCATIONAL RESEARCH

Now that the two main approaches to research have been made explicit in terms of how their proponents would present them, it is timely to consider how each is situated in the research enterprise in general. To assist in this understanding, it is useful to consider the model put forward by Popper and Eccles (see Figure 1 next page) that posits that there are three different worlds involved in human enquiry (Keeves 1997, p. 1-3):

- World 1** (the Real World) - comprised of entities, including natural physical objects, people, and human constructions and activities;
- World 2** (the Learner’s Mind) - subjective experiences, mental states, conscious thought and psychological dispositions, unconscious states of mind, human wisdom; and
- World 3** (the Body of Knowledge) - an objective world comprised of the corporate body of propositional knowledge concerned with causal explanations. Includes human endeavours of art, music and literature which are part of the world of shared knowledge.

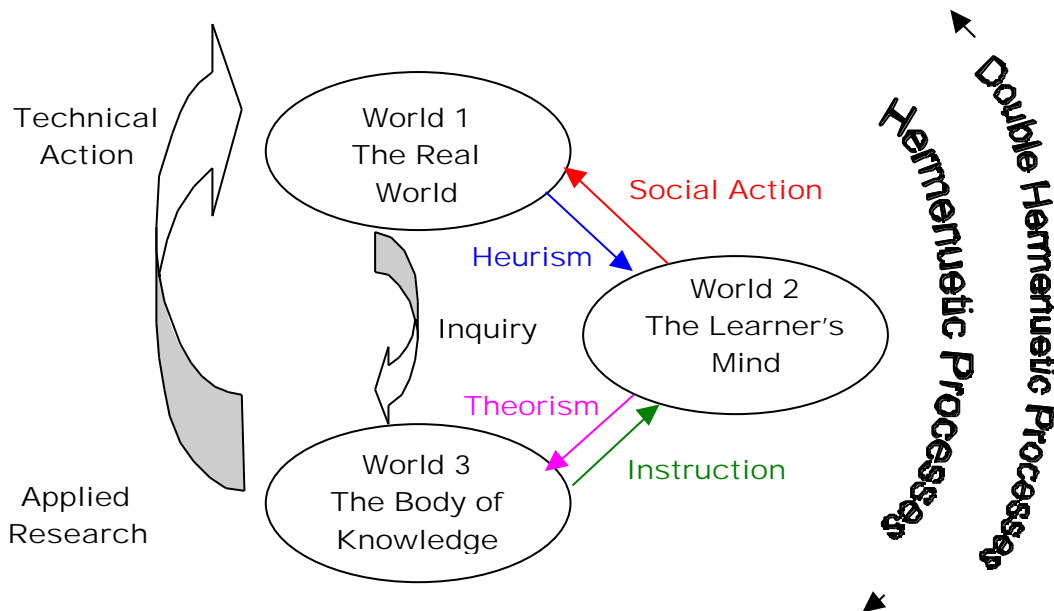


Figure 1: The Nature and Processes of Educational and Social Enquiry¹⁰

⁹ The diagram is not meant to be exhaustive. It merely lists some of the commonly encountered interpretivist approaches and how they are generally classified by virtue of their characteristics. Also, it is important to recognise that a particular research design may utilise a ‘hybrid’ of approaches to achieve its goals.

The model conveniently separates our one, complex world into three and provides an insight into cognitive processes associated with learning and enquiry. In the same way that each of us can look at our 'one world' from a certain perspective, we can now dissect it and transpose this view onto the three worlds in the model. This is useful for understanding how the various research approaches are traditionally distinguished from each other, particularly with regard to the way that they view 'reality' and 'knowledge' as they apply to Worlds 1 and 3 (see Table 1 also).

All research approaches claim to investigate World 1, the Real World, but it is the way they view this world and what they feel is generated by the enquiry which differentiates them¹¹. Both the quantitative and qualitative researchers would claim that their investigations of World 1 enable them to make contributions to World 3. It is clear, however, that they see World 1 in fundamentally different ways. For quantitative researchers, World 1 (the Real World) is independent from what the human mind thinks it is. For qualitative researchers, however, human thinking makes World 1 'what it is'. Both camps would recognise World 2 although, again, from different perspectives. From yet another perspective, the criticalists and postmodernists maintain that World 1 and World 2 are distorted realities and that World 3 is made false by value-laden knowledge claims which are ideologically driven and which promote oppression. They believe, therefore, that traditional empirical and interpretative approaches, by lacking a critique of the worlds they investigate, do little to change social reality and, therefore, assist hegemonic powers to perpetuate conditions which dominate and oppress.

Paul and Marfo (2001) present what is essentially a political argument for the recognition of a paradigm shift in educational research. Pointing to the hegemony of quantitative methods in educational research for most of the 20th century they assert that there is currently, and has been for two decades, an increasing awareness and use of qualitative methods in educational research. Quantitative research they link to logical empiricism and qualitative research they link to an awareness of philosophical, moral and political values and their effect on the content and results of educational research. They then argue for the expansion of researcher's knowledge of the history, philosophy, sociology and ethics of inquiry so that educational research will cease to be pursued solely in a quantitative vein. But at the same time they point to a paradigm shift in the way that science is conceived such that the shift is:

“...not about a counterforce; it is more about the collapse of the intellectual framework of empiricist science. The issue is the normative understandings that guide the work of social scientists. The “new science” is not an add-on but rather a change in the way we think about, conduct, share, and defend research.” (Paul and Marfo 2001, p. 527)

They argue for the recognition of multiple paradigms of inquiry with no one paradigm establishing a hegemony.

Four years earlier Walker and Evers (1997), in considering the same issue, had distinguished three theses: the oppositional diversity thesis; the complementary diversity thesis; and the unity thesis (pp. 22-30). They argue that there is a quantitative/qualitative debate in which two fundamental paradigms are distinguished. The quantitative paradigm is linked to scientific methodology and the use of mathematics and measurement. The qualitative paradigm is linked to the interpretation of human action by attempting to understand it. They refer to Husén and quote with approval his summation of the distinction;

¹⁰ Diagram adapted from its presentation in Keeves 1997, p. 2

¹¹ It is also logically possible to investigate Worlds 2 and 3 as well the connections between them, although this would probably be done via their existence as World 1 phenomena.

“The twentieth century has seen the conflict between two main paradigms employed in researching educational problems. The one is modelled on the natural sciences with an emphasis on empirical quantifiable observations which lend themselves to analyses by means of mathematical tools. The task of research is to establish causal relationships, to explain (Erklären). The other paradigm is derived from the humanities with an emphasis on holistic and qualitative information and interpretive approaches (Verstehen).” (Husén 1988, p. 17)

The three theses are ways of conceiving of the quantitative/qualitative distinction and its effects on educational research;

1. The oppositional diversity (OD) thesis revolves around a conflict between quantitative and qualitative approaches which is a conflict between a paradigm that presupposes a mind-independent reality where research is an attempt to produce something that corresponds to reality and a paradigm that presupposes that there is no mind-independent reality and research is aimed at understanding the constructs that human beings produce and which guide their actions. The weaker version would confine itself to making such claims about social reality and emphasise that educational research is research about the social reality of human beings. The paradigms are incommensurable.
2. The complementary diversity (CD) thesis supports a notion of paradigmatic pluralism. Different paradigms have their place in researching the complexity of the education of human beings. No one paradigm is capable of doing the job. The paradigms are incommensurable.
3. The unity (U) thesis is the thesis that there are not distinct, incommensurable paradigms but paradigms that can work together or in competition to the benefit of the research. They argue for a ‘touchstone’ which enables a researcher to decide between approaches.

The OD and CD theses both presuppose that the paradigms are incommensurable. The U thesis argues that they are not. The OD and CD theses involve the idea of distinct paradigms existing within distinct traditions. The U thesis is the view that distinct paradigms whether or not in distinct traditions can work together in an enquiry into a common problem. The description of the qualitative paradigm is a restricted view of that paradigm to which we shall return later. We would also argue that the notion of a ‘touchstone’ is a Kantian myth which has been sought for over two hundred years without success.

Walker and Evers (1997) commence by saying that;

“The major epistemological question here is whether these distinctions are associated with different ways of knowing or forms of knowledge, which partition educational research so that research traditions, for example, turn out to be radically distinct epistemologically, each having its own theories and rules of justification, meaning, and truth. If so, the next question is whether findings produced by the different traditions can be rationally integrated, rendered coherent, or even compared. For this to be possible, for traditions to be commensurable, there will have to be some shared concepts and standards of justification, meaning, and truth; some epistemological touchstone. If, however, the traditions are so fundamentally disparate that any choice between them in educational research is arbitrary or the result of nonrational commitment – an act of faith – there is no touchstone. The research traditions are incommensurable.” (p. 22)

We shall use the term traditions as indicating distinct ways of looking at the world of our experience in that they are founded on a distinct set of ontological and epistemological beliefs. This set includes basic approaches to rationality. Paradigms, or in Walker and Evers term, theories, exist within traditions. We shall then argue that traditions and the paradigms within them are not incommensurable and can be rationally compared and evaluated thus leading to the conclusion that quantitative and qualitative approaches can be complementary. We reject the touchstone argument, it is in our view a consequence of the Kantian attempt to find axioms which any rational person must accept. This attempt has always been a failure.

Within the natural sciences there have been a succession of paradigms. For instance, in physics, classical mechanics was followed by Einstein's view of the world. One paradigm succeeded another. These paradigms are ways of conceiving and explaining reality and while they can be very different they all arise within the same tradition of enquiry, a tradition that has a particular history and presupposes the possibility of an empirical explanation of reality without reference to any norms. In contrast to this there is the paradigm that gave way to classical mechanics, medieval Aristotelian mechanics. This paradigm was conceived within a different tradition which had at its base the conception that all things had a final end. Aristotelian mechanics had a teleological base in that it arose within a tradition that viewed the world and its inhabitants through a teleological perspective. The practice of physics within a tradition is pursued from the presuppositions of that tradition. This directs the practice towards particular explanations and admits particular paradigms. So in Aristotelian mechanics things fell towards the earth because they were seeking their preferred state – a teleological explanation. In classical mechanics things fall towards the earth due to gravitational attraction – an explanation compatible with presuppositions that recognise an empirical/valuative distinction. All traditions arise and live within a culture and their history in the beginning is a history of that culture. The narrative of the history of a tradition can, from its original beginnings, encompass many changes and modifications. The Aristotelian tradition is still with us having passed through medieval times and the Galilean revolution. It has changed with the passage of time. Aristotelian mechanics is the mechanics of a tradition born in an Athenian culture of a particular time. The tradition was changed and modified as time passed but even in the 13th century it retained its teleological approach. A different tradition had its seeds in Galileo's work and was formed by the Enlightenment. Any given tradition may thus contain a number of paradigms which in turn may change and be modified and be discarded without destroying the tradition. Traditions are distinguished by their particular set of ontological and epistemological commitments.

There is a radical difference between competing paradigms within a tradition and competing paradigms from different traditions. When Boltzmann set out the anomalies that arose in attempting to give an account of thermal energy within the paradigm of classical mechanics there existed a crisis in classical mechanics. The crisis was resolved by Bohr's theory of the atom. But the resolution was more than that. It modified the paradigm. The point is that within a tradition there can be conflict and argument and change. In fact it is better to say that change is necessary within a tradition if it is to continue to be a live force. Where anomalies exist, which they must, then the epistemological struggle is one to relieve the paradigm of the incoherencies and produce a new or modified paradigm which at one and the same time solves the incoherencies and gives an account of why they were bound to occur. In this way a paradigm within a tradition has a continuous history and the narration of that history is an account of the enquiry, its success and its change over time. The conflict between paradigms within a tradition is a conflict fought and resolved using common epistemological and ontological standards, the standards of that particular tradition.

The situation of competing paradigms from different traditions is one that has fuelled the belief that the paradigms are incommensurable. Each paradigm within each tradition will, to the extent that the tradition is coherent, exist and be evaluated according to the internal standards of the tradition. If these standards are incompatible as between traditions, which they must be if the traditions and paradigms are to be distinguished, then each tradition and paradigm is adjudged incoherent by the standards of the other. One response to this is to seek a touchstone. The incommensurability is derived from the differing epistemological and ontological standards of the different traditions within which the paradigms exist. To resolve

the incommensurability a source of epistemological and ontological standards are sought which are outside of and independent of the incommensurable traditions.

Another response is to deny that rational debate between competing traditions is possible, everything is relative to the tradition within which it exists. This is then enlarged to the usual relativist thesis concerning cultures and knowledge. If both traditions are coherent within themselves but incompatible with other traditions then no tradition can make any successful claim to truth. On this basis an Aristotelian approach is incompatible with a Newtonian approach and, because no external independent touchstone is possible, then, no resolution is possible. An Aristotelian teleological approach to natural science may be internally consistent but incompatible with a Newtonian empirical approach but there can be no possibility of a decision as to which is more reasonable. We suggest that this is, in part, the thinking that lies behind the suggestion of multiple paradigms by Paul and Marfo and by the arguments of Walker and Evers.

We suggest that it is a mistake to think that distinct paradigms existing within distinct traditions are incommensurable. Consider first the assessment within a tradition of an existing paradigm facing attack from within as classical mechanics was from Boltzmann. The first step in assessing a paradigm is always to attempt to show that by the internal standards of the tradition the paradigm is incoherent. This Boltzmann did. The second step is to attempt to show that a new proposal solves the incoherence and gives an account of why it was bound to occur. This Bohr did. Note that the second step will involve giving a narrative of the paradigm for it came into existence originally to solve certain problems which had presented themselves. A history of a paradigm is, on this view, an essential part of understanding the paradigm, its weaknesses and whether or not a solution has presented itself. Note also that the step involves showing why the problem was bound to occur. This goes to an assessment of the weakness of the paradigm and provides a justification for seeking a solution. A third step is not essential but would consist in starting to consider what incoherencies are bound to occur within the new proposal. The presupposition here is that while the final end of the enquiry may be the truth, the pursuit of the enquiry will yield only steps towards that final end and these steps will necessarily contain flaws which hopefully will be corrected (Einstein and Infeld 1938). This serves to direct the future of the enquiry. Why is it thought that this methodology cannot be followed when considering paradigms within competing traditions? It is essentially a rational methodology and should be applicable. However, let us first apply the methodology to quantitative research in education.

Educational research is research about human beings. In the 17th and 18th centuries the empiricist explanation of a human action was based on a search for the physiological mechanisms. Human action was conceived of in mechanistic terms and it was supposed that the study of human action would yield universal laws in much the same manner that Newton's study of the world had yielded the laws of dynamics. In such a situation human action would become predictable much as the orbit of the planets and comets, both known and unknown, were predictable.

Kant accepted the incompatibility between any account of human action couched in mechanistic terms and the language of morals. Moral language was concerned with human action based on maxims and rules. The science of human action was based on the search for and exposition of the mechanical causes of the ways that human beings behaved. Finding the two incompatible Kant asserted that moral language is inexplicable in scientific terms (Benn and Peters, 1959, p.47). There is a gap between science and values which cannot be bridged because there is no possibility of explaining the inexplicable. So concepts central to morality

such as intention, purpose, virtue, and good which we ascribe to human action become unintelligible to those pursuing scientific research into human action. The gap between 'ought' and 'is' becomes an accepted part of the intellectual landscape and the acknowledgement of its existence is seen as an achievement of modern, that is, Enlightenment, thought.

"This distinction between normative rules and scientific laws, which is here regarded as basic to our understanding of society, was made explicit comparatively late in the history of thought – probably in Europe in the eighteenth century." (Benn and Peters 1959, p. 16)

To the present day it has been accepted that a mechanistic explanation of human action, if it is to remain true to its attempt to explain human action by quantifying it and seeking universal laws akin to those of natural science, must find human action inexplicable as described in terms of intention and purpose. Quine has argued that any attempt to study human action scientifically must eradicate all mention or allusion to intention and purpose. This is the origin of quantitative research and for many it has not and should not deny its origins.. The task is to emulate the physics of classical mechanics.

Is the quantitative research paradigm incoherent? Consider a stranger drinking a liquid from a container. We can describe the mechanics of the situation. If we have sufficient physiology we can describe what is happening beneath the exterior of the body that we see before us. We can give the circumstance a cultural context by recognising that the container is a wine glass and that the liquid is red. But while we can describe the mechanics and by looking at the cultural context we can guess that the stranger is drinking red wine we cannot with any surety give a description of the human action which is taking place. The act of drinking the red wine may be described as:

"...an act of self-indulgence, an expression of politeness, a proof of alcoholism, a manifestation of loyalty, a gesture of despair, an attempt at suicide, the performance of a social rite, a religious communication, an attempt to summon up one's courage, an attempt to seduce or corrupt another person, the sealing of a bargain, a display of professional expertise..." (Ayer 1964, p. 7)

The point being that the stranger is the final authority on what he or she is doing. How he or she sees their behaviour is what makes the action the action that it is. The mechanics are the same; the action differs. In the same way measurement of human behaviour may capture the mechanics of the circumstance but misses the humanity of the behaviour. This is the problem that quantitative research of human action must face. It is a problem that arises from following the empirical/normative distinction in the sphere of human action.

Consider a metal bob attached to a string which in turn is attached to a beam. The bob is swinging to and fro. If we ignore the air pressure, the friction at various points, the elasticity of the string and keep the arc through which the bob swings below 30° then, by using mathematics we can come to the formula " $T = 2\pi\sqrt{l/g}$ " where 'T' = period of the bob, 'l' = length of the system and 'g' = gravitational constant. This is a curious achievement. All mathematics can be represented as a system of exact concepts. An exact concept is one that does not permit of the neutral case.

"...that is, a case in which both the assigning of the concept and a refusal to assign conform to the concept-governing rules. To put it another way, a circle is either a circle or it is not ... there is no such thing as a borderline case." (Gibbons 1979, p. 323)

On the other hand the physical system of the bob can only be given an inexact physical description for all empirical concepts are inexact. The sets of exact concepts and inexact concepts are mutually exclusive and the consequence of this is that in order to attempt a mathematical description of the a swinging bob, it is necessary to idealise the situation. That is, the situation must be made an exact situation so that mathematical concepts have purchase. As a result the formula of the simple pendulum " $T = 2\pi\sqrt{l/g}$ " is divorced from

reality. This was precisely Galileo's point when his critics pointed out that no simple pendulum conforms to a standard swinging pattern. The key to physics, and to any science that uses mathematics, is to understand that an ideal description of the system must be created so that mathematics can do its work. The problem is then to apply any mathematical results to the real world. There has to be something similar to the process by which the ideal situation was created but in reverse. Educational research in its quantitative guise has sought to use mathematics and it faces the same problem that physics and other natural sciences face. It faces the same problem which anybody faces if they intend to apply the results of the mathematics to the real world. A good example of the way in which the problem is actually overcome is the use of 'fudge factors' by engineers to compensate for discrepancies between theoretical engineering ideas and their application in the real world.

Quantitative research was bound to face problems arising from the nature of human beings and the nature of mathematics. As a result, it becomes incoherent.

Qualitative research, as defined by Walker and Evers, comes under attack from all the arguments that have been used against constructivism and relativism. It is beyond the scope of this paper to rehearse those arguments; they have been expounded in detail by Kukla (Kukla 2000) and there is sufficient evidence to argue that it is reasonable to consider that qualitative research as defined by Walker and Evers is incoherent.

There is a further argument that is relevant. The point of educational research is not to enlighten us about the particularities of an individual but to enlighten us about groups. Research in a qualitative mode which eschews any quantitative approach necessarily confines itself to the individual and cannot extend its findings to the group. It is the same problem as that of applying mathematical formula to a 'real world' system. In order for the findings about a unique individual to be generalised across a group, the group must be idealised in the sense that certain features are used, others ignored. The situation is analogous to the pendulum and the problem is the same.

The U thesis argues that the quantitative and qualitative paradigms are commensurable. This can be taken to mean that either it is possible to compare paradigms from different traditions or that both the quantitative and qualitative paradigms exist within the same tradition. We would argue that the quantitative and qualitative paradigms as defined by Walker and Evers exist within different traditions and therefore they are committed in the U thesis to the possibility of comparison between paradigms from different traditions. It is unclear how they expect this to occur. They also appear committed to the notion that the quantitative and qualitative paradigms can work together, in a sense combining their strengths. An example of the way that this may be taken to occur has come about with the advent of powerful computers and specific software.

Over the past thirty or so years, one way that people have distinguished the two approaches is by designating *quantitative research* as 'number-crunching' which seeks explanation by reducing reality to its component parts and representing it numerically as formulae or establishing its place in the world by means of descriptive or inferential statistics. It would not be drawing a long bow to suggest that this characteristic has often been a way in which researchers from both approaches have given each other a hard time. The qualitative researcher says of the quantitative researcher "they're just number-crunchers", to which comes the retort "your lack of such activity confirms my suspicion that your research is not good research". With the advent of more compact, efficient, powerful, accessible, and transportable computers, however, the time of this superficial distinction can be said to be well and truly over.

“Since the 1960s, the computer has become the daily companion of the researcher. For the first time in the history of humankind, the amount and complexity of calculation are no longer a major problem. Already existing statistical techniques, like multiple regression analysis, factor analysis, multivariate analysis of variance, that previously too onerous for desk calculation, suddenly became accessible in a few moments.” (de Landsheere 1997, p. 14)

The important point here is that not only is this seen as benefiting quantitative researchers, but many qualitative researchers are beginning to sort and code data for computer analysis (Burns 1999, p.14). The most commonly used packages include ez-text, ETHNOGRAPH, Atlas.ti and NUD*IST, all of which offer a qualitative content analysis package for verbal material. Another more recent software application, NVivo, takes qualitative inquiry beyond coding and retrieval. It integrates coding, links data to external multimedia data, websites or internal documents or concepts, stores ideas flexibly in annotations and rich text memos that can be coded, linked and searched, manages rich data, and allows information in tables to be imported from or exported to statistics packages (QSR 2002).

It is interesting to observe mixed reactions to the emergence of computer assisted qualitative data analysis software (CAQDAS). Some researchers have embraced the opportunity that automation provides in terms of (i) speeding up and enlivening the coding process, (ii) providing a more complex way of looking at the relationships in the data, (iii) providing a formal structure for writing and storing memos to develop the analysis; and (iv) aiding more conceptual and theoretical thinking about the data. Others, however, see the introduction of software as the 'the dark side of the technological advance' and are concerned that it will (i) distance people from their data, (ii) lead to qualitative data being analysed quantitatively, (iii) lead to increasing homogeneity in methods of data analysis, and (iv) that it might become a 'monster' and hijack the analysis (Barry 1998). There is another problem. Does the coding of qualitative results purport to treat valuative terms mathematically in defiance of the is/ought distinction, or does the coding of qualitative results in mathematical terms proceed by ignoring the valuative elements and thus preserving the is/ought distinction? Has Hume and the Enlightenment been abandoned or does it continue to reign (Couvalis, 1997, p. 2)? Whichever answer is given, wherein lies the justification? We suggest that the users of such computer software must confront the ontological and epistemological issues involved in their use.

COMPARING ACROSS TRADITIONS

We propose to attempt an argument to show that paradigms from different traditions can be compared rationally and also that there is a paradigm of qualitative research which has so far received no mention and which is in current use in some natural sciences.

A paradigm exists within a tradition and a tradition is, as the name suggests, something that has its origins in a particular society and the beliefs of that society. The tradition will, while it remains alive, grow and change throughout its history. The history of a tradition is an account of the existence, change and coherence of the tradition. Consider Galileo. Aristotle, that philosopher of common-sense, dominated thinking about mechanics for over 1800 years. It was Aristotle's mechanics that Galileo studied as a student at Pisa and his first work as a scientist was to annotate Aristotle's *De Caelo*. There are some aspects of Aristotle's mechanics to which we wish to draw attention and compare with Newtonian mechanics.

Firstly, for Aristotle, all motion required a moving force. This force could be, in the case of heavy bodies, the attraction towards its natural place, the centre of the earth, or a force applied to the body such as a push. Inertia was a state of rest and all motion had to be accounted for by reference to a force. This accords well with our everyday experience, for an

object does rest unless it is pushed and will stop moving if we cease pushing. Motion is a change of position. And it was in giving an explanation of such observations that Aristotle was led to say;

“Everything that is in motion must be moved by something. For if it has not the source of its motion in itself it is evident that it is moved by something other than itself.” (Aristotle 1984, 241b, pp. 34-35)

At the centre of Aristotelian dynamics is the idea that bodies move against constant resistance; inertia is defined as a state of rest. Our language contains within it the Aristotelian idea of inertia. The dictionary describes ‘inert’ as having no inherent power of action, motion, or resistance and ‘inertia’ as inactivity.

This is in contrast to Newtonian mechanics. The axioms or laws which appear in the *Principia* can be stated as:

1. Every body continues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by force or forces acting upon it;
2. The change of momentum of the body is proportional to the force acting upon it; and is made in the direction of the straight line in which the force is directed;
3. To every action there is an equal and opposite reaction.

The basic principle of Newtonian mechanics lies in the first law. It is a law of inertia and is in direct contrast to that of Aristotle’s. It was prefigured by Galileo with his axiom that a moving body on a frictionless level surface would continue to move with uniform motion to the limits of the plane. Galileo’s notion envisages motion around the plane of the earth, Newton’s motion was in a straight, Euclidean line. For Aristotle, space is finite and limited to that space within the sphere drawn by the fixed stars. Outside that sphere there is nothing. For Newton, on the other hand, space is Euclidean. It is infinite.

To grasp Newtonian inertia we must imagine an idealised system. Aristotle demanded no such exercise of the imagination. Consequently, any student with sufficient command of the English language to use either ‘inert’ or ‘inertia’ is confronted with a problem when confronted by Newtonian dynamics for they will tend to speak an Aristotelian language.

Newton’s second law is usually expressed as $F = m \cdot dv/dt$ where ‘F’ = force, ‘m’ = mass, and ‘dv/dt’ = rate of change of velocity with respect to time (acceleration). A more common form of expression is $F = m \cdot a$ where ‘a’ = acceleration. Again, in contrast with Aristotle, we are asked to imagine an idealised system. Our everyday experience is of heavier bodies falling faster and there is never an absence of resistance.

Newton’s third law is again a case of an ideal system in which there not only can be action and reaction in contact but also at a distance. In contrast, Aristotle’s approach was to consider that there could not be action at a distance and that all action which produces a reaction must be by way of contact. Nor was the reaction considered equal and opposite but dependent upon the circumstances of occasion.

Aside from the detail of the laws, Newtonian mechanics demands that we see the world with which we are concerned in an idealised way. This approach was adopted by Galileo in his work on the pendulum and it enabled mathematics to be applied to physical problems.

Aristotle did not conceive of his mechanics as applying to an ideal system but to the real world. He is thus limited in the use to which he can put mathematics (should he have wished to do so).

Clearly, the learning of Newtonian mechanics by students poses problems. The main problems are that students are asked to put to one side their everyday notions, that is, their Aristotelian notions, and enter via their imagination into a different way of seeing the physical world which they inhabit. It might be thought that this is merely the problem of learning another approach to put alongside their previous commonsensical approach. Students, as people, are accustomed by the time that they reach adolescence to wearing different hats for different occasions; this is just one more hat. And yet the anecdotal evidence and the evidence in the literature suggests that students find this very difficult at times.

It is evident that science teachers are confronted with a problem. The world that their students observe is an Aristotelian world. The problem for the teachers is to get the students to change their point of view and look at the world as an idealised system in order to comprehend modern physics. This problem has been commented on before (Ebison 1993, Lombardi 1999) with little more than injunctions for teachers to be aware of the problem.

The problem is not insoluble; the solution lies in 'translation' from one tradition to another. And this, we would suggest, is the solution to alleged incommensurability. It is similar to the problem confronting language teachers when they attempt to get pupils to learn a second language. It is possible to learn a second language in the sense that it enables a person to get around a country and a culture without too much fuss but with little grasp or contact with that country and culture. If there is to be a worthwhile contact with that country and culture then the second language must become as a first language. Only then is it possible to understand and partake of the beliefs and attitudes of that culture. The same is true of different traditions. The scientist immersed in classical mechanics must learn the language of the Aristotelian tradition of mechanics if they are to understand the coherence and incoherence of that paradigm within a particular tradition. That is the first step. The second step is to ask whether or not the Aristotelian tradition brings with it insights which are superior or inferior to those from the tradition within which classical mechanics is embedded. In this way it is possible to compare and contrast paradigms within traditions rationally. Certainly there may be elements in a tradition and its paradigms which are incommensurable just as it is impossible to translate certain phrases from one language to another but, accepting this, it is still possible to make significant comparisons and assessments. For instance, the Italian 'simpatico' has no direct translation into English but can be understood by giving a lengthy explanation which would include references to Italian culture and belief.

Can the Aristotelian view of the change of motion of a body be expressed in the language of classical mechanics with sufficient exactness to enable a comparison and evaluation? Newton's second law is $F = m \cdot dv/dt$, or its more common form of expression, $F = m \cdot a$. In the terminology of classical mechanics, it has been said that for Aristotle, $v = k F/R$ (where 'F' = force, 'k' = a constant, 'v' = velocity, and 'R' = resistance (Stinner 1994, p. 78). We would argue that the translation is sufficient for the purpose of a rational comparison. And this is a translation between traditions.

Quantitative and qualitative research, as normally conceived, are different paradigms within different traditions. To compare their merits the researcher in one paradigm must understand the other as well as their own. Throughout the argument so far the science that grew with the Enlightenment has been presented in terms of the idealised world of classical mechanics. This emphasised a break with the Aristotelian tradition. However one paradigm from the Aristotelian tradition was not discarded; that of the teleological paradigm. Both chemists and biologists have continued to think and pursue their enquiries in terms of 'natural kinds'.

Quantitative research has historically taken physics as its exemplar and this has in great measure produced the quantitative/qualitative distinction and divide. We would argue that the teleological paradigm as it occurs in chemistry and biology is worthy of consideration. It offers the opportunity to combine in a significant and complementary fashion, both quantitative and qualitative research. We have also argued that quantitative and qualitative research paradigms are commensurable. If so, then they can work together.

Keeves (1997) suggests that investigative approaches to educational research should embrace a coherent approach in terms of *methods* and *outcomes*. With regard to the former, “the methods employed in educational enquiry should ... be influenced by the nature of the problems being considered” (p. 6). With regard to methods, one should recognise the situational strengths and weaknesses of particular investigative instruments. Slade (2002) concurs and states that is best to remain open to employing a diversity of methods as the research problem demands and doing so exemplifies the logic, pragmatism, and importance of remaining flexible to meet the emerging needs of the investigation at hand (p. 98). These views entail commensurability. It is acceptable that *methods* from both the scientific and humanistic approaches can indeed be complementary in any given investigation. We have tried to show what questions must be asked if this is attempted. Further, it is logically possible for different methodologies, i.e. quantitative and qualitative, to work collaboratively in social science and educational investigations. Husén (1997) makes this clear by use of an example of research from teaching which ‘mixes paradigms’ constructively to demonstrate how human behaviour in a single classroom can be interpreted in a national or international context (by quantitative means) as well as the classroom itself as a unique phenomenon (by qualitative means) (p. 20). As de Landsheere (1997) suggests of research throughout the 1990s, it is no longer either-or, but both as “the scientific approach is seen to be complementary to the anthropological, historical, phenomenological, or humanistic approach” (p. 9). In this sense, the idea of a ‘unity of purpose’ in educational research can be supported in terms of respecting the capacity of quantitative and qualitative paradigms to add clarity to understanding human behaviour.

Keeves and Slade, go a step further, however, and argue that a ‘unified’ or ‘coherentist’ approach to research not only implies a complementary association between quantitative and qualitative methods and methodologies, but that the traditional separation of these research methodologies into different camps, often antagonistic to each other, is fallacious on epistemological grounds. We concur for the reasons developed throughout this paper.

REFERENCES

- Aristotle. (1984). *Physics*. In Barnes, J. (Ed.), *The Complete Works of Aristotle. Revised Oxford Translation*. Princeton NJ: Princeton University Press.
- Arnove, F. (1999) Introduction: Reframing Comparative Education: The Dialectic of the Global and the Local. In Arnove, F. & Torres, C. (eds) *Comparative Education: The Dialectic of the Global and the Local*, pp 1-25. Lanham: Rowman & Littlefield.
- Ayer, A. J. (1964). *Man as a Subject for Science*. London: Athlone Press.
- Barry, C. (1998) Qualitative Data Analysis Software: Atlas/ti and Nudist Compared. In *Sociological Research Online*, 3(3). Available on-line <http://www.socresonline.org.uk/socresonline/3/3/4.html> [2002, 26 September].
- Beare, H. and Slaughter, R. (1995) *Education for the 21st Century*. London: Routledge.
- Benn, S. I., & Peters, R. S. (1959). *Social Principles and the Democratic State*. London: Allen and Unwin.

- Bogdan, R. & Knopp Biklen, S. (1992) *Qualitative Research for Education: An Introduction to Theory & Methods* (2nd ed). Boston: Allyn & Bacon.
- Bosetti, L., Landry, D. & Miklos, E. (1989) *Critical Perspectives on Educational Planning and Policy Analysis*. In *The Canadian Administrator*, 29(2) November, pp. 1-7.
- Bradford DeLong, J. (2001) *The World's Income Distribution: Turning the Corner?* Available on-line: http://econ161.berkeley.edu/TotW/world_income_dist.html [2002, Sept 6]
- Bronowski, J. (1973). *The Ascent of Man*. London: British Broadcasting Corporation.
- Burns, R. (1990) *Introduction to Research Methods*. Melbourne: Longman Cheshire
- Burns, R. (1999) *Introduction to Research Methods* (4th ed). Frenchs Forest: Longman
- Carr, W. & Kemmis, S. (1986) *Becoming Critical: Knowing through Action Research*. Victoria: Deakin University Press.
- Carspecken, P. (1996) *Critical Ethnography in Education Research: A Theoretical and Practical Guide*. New York: Routledge.
- Connole, H. (2000) *The Research Enterprise*. In Smith B (ed) *Issues and Methods in Research (Study Guide) UED601/SG/01/ver2*. Underdale: The University of South Australia.
- Couvalis, 1997, *The Philosophy of Science*. London: SAGE Publications.
- Cribb, J. (2002) *Share the Good Word on Unis*. In *The Australian* (Higher Education supplement, Wednesday 5 June 2002).
- de Landsheere, G. (1997) *History of Educational Research*. In J. Keeves (ed) *Educational Research, Methodology, and Measurement: An International Handbook* (2nd ed) Cambridge: Pergamon.
- Doordan, A. (1998) *Research Survival Guide*. Philadelphia: Lippincott-Raven Publishers.
- Ebison, M. G. (1993). *Newtonian in Mind but Aristotlean at Heart*. *Science & Education*, 2, 345-62.
- Einstein, A., & Infeld, L. (1938). *The Evolution of Physics*. New York: Simon & Schuster.
- Gibbons, J. A. (1979). *Curriculum Integration*. *Curriculum Inquiry*, 9:4, 322-32.
- Grazino, A. & Raulin, M. (1996) *Research Methods: A Process of Enquiry* (3rd ed). New York: Longman.
- Husén, T. (1997) *Research Paradigms in Education*. In J. Keeves (ed) *Educational Research, Methodology, and Measurement: An International Handbook* (2nd ed) Cambridge: Pergamon.
- Keeves, J. P. (1997). *Models and Model Building*. In Keeves, J. P. (Ed.), *Educational Research: Methodology and Measurement. An International Handbook*. (pp. 386-94). Oxford: Pergamon.
- Keeves, J. (2002) *Research in Education: Nature, Impact, Needs and Priorities*. Unpublished draft.
- Kukla, A. (2000). *Social Constructivism and the Philosophy of Science*. London: Routledge.
- Lakowski, G. (1997) *Critical Theory and Education*. In Keeves, J. (ed) *Educational research, methodology, and measurement: an international handbook* (2nd ed). Cambridge: Cambridge University Press.
- Lombardi, O. (1999). *Aristotleian Physics in the Context of Teaching Science: a Historical-Philosophical Approach*. *Science & Education*, 8, 217-39.
- McCalla-Chen, D. (1996) *A Trifle Experience: Centre Ground Approach to Research*. Draft paper for presentation at the BERA Conference, Lancaster University, 12-15 September 1996. Available on-line: <http://www.leeds.ac.uk/educol/documents/000000124.doc> [2002, 3 Sept].

- MacIntyre, A. (1988) *Whose Justice? Which Rationality?* Indiana: University of Notre Dame Press.
- Miriam-Webster (2002) *Collegiate Dictionary*. Available on-line: <http://www.m-w.com/cgi-bin/dictionary> [2002, 12 September].
- Paul, J. L., & Marfo, K. (2001). Preparation of Educational Researchers in Philosophical Foundations of Inquiry. *Review of Educational Research*, Winter 2001 Vol 71, No. 4, pp. 525-547.
- QSR (Qualitative Solutions and Research) (2002) Products / Nvivo. Available on-line: <http://www.qsr-software.com/products/nvivo.html> [2002, 26 September].
- Rizvi, F. (1986) Bureaucratic Rationality and the Possibility of Democratic Governance in Education. In *The Australian Administrator*, 7(1) February 1986, pp. 1-4.
- Slade, M. (2002) Listening to the Boys: Issues and Problems Influencing School Achievement and Retention. In *Flinders University Institute of International Education Research Collection: Number 5*. South Australia: Shannon Research Press.
- Smith B (ed) (2000) *Issues and Methods in Research (Study Guide) UED601/SG/01/ver2*. Underdale: The University of South Australia.
- Smith, K. (1989) *The Nature of Social & Educational Enquiry: Empiricism versus Interpretation*. New Jersey: Ablex.
- Stinner, A. (1994). The Story of Force: from Aristotle to Einstein. *Physics Education*, 29, 77-85.
- US Census Bureau (2002) *Total Midyear Population for the World: 1950-2050*. Available on-line: <http://www.census.gov/ipc/www/worldpop.html> [2002, 5 Sept].
- Walker, J. C., & Evers, C. W. (1997). Research in Education: Epistemological Issues. In Keeves, J. P. (Ed.), *Educational Research, Methodology, and Measurement: an International Handbook 2nd ed.* (pp. 23-31). Oxford: Elsevier Science.
- Welch F. (1999) The Triumph of Technocracy or the Collapse of Certainty? Modernity, Postmodernity, and Postcolonialism in Comparative Education. In Arnove, F. & Torres, C. (eds) *Comparative Education: The Dialectic of the Global and the Local*, pp. 25-49. Lanham: Rowman & Littlefield.
- Williamson, K. (2000) *Research Methods for Students & Professionals: Information Management & Systems*. Wagga Wagga: Charles Sturt University Centre for Information Studies.