(Sammons, P. & Davis, S. (2017) Mixed Methods Approaches and their Application in Educational Research Chapter 23 in Dominic Wyse, Neil Selwyn, Emma smith and Larry E. Suter (2017) *The BERA/Sage Handbook of Educational Research* Volume 1 London: Sage)

Mixed Methods Approaches and their Application in Educational Research Pamela Sammons and Susila Davis

Department of Education, University of Oxford

Abstract

This chapter discusses the use of mixed methods approaches in educational research and provides examples that document the way mixed methods designs and approaches have been employed to study complex educational questions. The main features of some common mixed methods designs will be explored building on, and elaborating, discussions by Tashakkori and Teddlie (2003; 2010). The way mixed methods research can be used to investigate complex social phenomena, reveal patterns and associations, provide generalisations and develop and test theories and also provide rich evidence to illuminate understanding of educational topics is discussed. The chapter uses several studies as exemplars to highlight the potential of mixed methods research in studying classroom practice and to illustrate the way both quantitative and qualitative data can be analysed and the results integrated. Two are research studies that address a number of questions about the variation in teachers' classroom practice and the third study is an evaluation that studies the

practice of a specific group of teachers, those trained via Teach First. The chapter compares the kinds of research questions addressed by the qualitative and quantitative strands of these three studies and highlights the sequencing of the research, the ways different kinds of data were analysed and linked and the processes of integration and synthesis. It explores the methodological challenges faced, the knowledge claims made and how the authors substantiated their findings and conclusions.

Keywords & phrases (also for index)

Constructivist

Effective classroom practice (ECP)

Longitudinal

Mixed methods (MM)

Multimethod

Multilevel statistical analysis

Paradigms

Post-positivist

Qualitative

Quantitative

Repertory grid

Teach First

Teacher effectiveness

Teaching and Learning Research Programme (TLRP)

Value added

Value added, Contextualised

Variations in Teachers' Lives Work and their Effects on Pupils (VITAE)

Biographical statements

Professor Pamela Sammons BSocSci PhD HEA

Pam Sammons is a Professor of Education at the Department of Education, University of Oxford and a Senior Research Fellow at Jesus College, Oxford. Previously she was a professor at the School of Education, University of Nottingham (2004-2009) and a professor at the Institute of Education University of London (1993-2004). Her research over more than 30 years has focused on school effectiveness and improvement, school leadership, teaching effectiveness and promoting equity and inclusion in education. She has a particular interest in longitudinal studies and the use of mixed methods research approaches. Pam is a governor of a secondary school in Oxford.

Email pamela.sammons@education.ox.ac.uk

Susila Davis, B.Eng MSc

Susila Davis is currently studying for a doctorate in education at the University of Oxford. Her focus is on practitioner engagement with Oxford University Press Pathways to School Improvement. Her other research interests include youth programmes and alternative education provision. Susila was also a research and data analyst for several years at the Specialist Schools and Academies Trust.

Email susila.davis@education.ox.ac.uk

Glossary

Term	Description
Contextualised value added (CVA)	A statistical measure of pupil progress from one stage of education to a later stage (e.g. across one or more school years) that takes into account pupils' prior attainment as well as controlling external factors such as social deprivation.
DCSF DfE DfES	UK Department for Education known by different names under successive governments: 'Department for Education and Skills (DfES)' - 2001-2007 'Department for Children, Schools and Families (DCSF)' - 2007-2010 'Department for Education (DfE)' - 2010 to present
ESRC	Economic and Social Research Council, one of seven research councils (and a public body) that funds and supports peer-reviewed research in the UK.
Key Stage	A stage of pupils' education at different points during their school life in the UK. Each key stage marks expected levels of knowledge at various ages. Key Stage 1 Ages 5-7 Years 1 & 2 Key Stage 2 Ages 7-11 Years 3, 4, 5 & 6 Key Stage 3 Ages 11-14 Years 7, 8 & 9 Key Stage 4 Ages 14-16 Years 10 & 11
Local Authority (LA)	An administrative body that governs a particular geographical area in the UK
Teach First	A charity launched in 2002 to train and provide 'excellent' teachers in secondary schools within low-income communities in England and Wales. One of the main aims of the programme is to develop inspirational leaders in order to reduce educational inequalities. It is an alternative

	certification programme that built on the earlier Teach for America model.
Value added (VA)	A measure of pupil progress from one stage of education to a later stage (e.g. across one or more school years). Attainment is measured based on pupils' prior attainment. [see also Contextualised Value Added]

Mixed Methods Approaches and their Application in Educational Research

Chapter for the BERA Sage Handbook of Educational Research

Pamela Sammons and Susila Davis

Department of Education, University of Oxford

Introduction

This chapter discusses the use of mixed methods (MM) approaches in educational research and provides a brief review of methodological literature on MM in social research. It explores the growing popularity of MM to study complex educational questions and issues in the design of MM investigations. The chapter also discusses the arguments made to support the use of mixed methods as well as some of the potential problems that may be encountered.

Some of the main defining features of MM studies are explored, building on, and elaborating, discussions by Tashakkori and Teddlie (2003; 2010a). The way MM research can be used to investigate complex social phenomena, reveal patterns and associations, provide findings that can support generalisations and develop and test theories and also provide rich descriptions and identify patterns that provide evidence to illuminate and extend understanding of educational topics is discussed. The chapter draws attention to the way both quantitative and qualitative data can be collected, analysed and integrated to link findings and to support new, synergistic understandings that go beyond the findings and interpretations that can be achieved from reliance on only one methodological perspective.

The chapter uses several studies as exemplars to highlight the potential of MM research in studying classroom practice to address broader research questions and illustrate the way both quantitative and qualitative data can be analysed and the results integrated. The chosen examples have a common educational focus on studying teachers' classroom practice and teacher effectiveness and all were conducted in England during the last 15 years.

Two are longitudinal research studies and one an evaluation with a longitudinal component. The first two examples examine the MM design of the Variations in Teachers' Lives Work and their Effects on Pupils (VITAE) research (Day et al., 2006, 2007; 2008; Sammons et al., 2007) funded by the then Department for Children, Schools and Families (DCSF) in England and the follow-up Effective Classroom Practice (ECP) study (Day et al., 2008; Kington et al., 2011; 2014b) funded by the Economic and Social Research Council (ESRC). The third example studies the impact of 'Teach First' teachers in schools because this also addresses the notion of effective classroom practice and shows how MM can support studies that are designed to evaluate educational initiatives, in this case the role of Teach First teachers in supporting school improvement. This study was commissioned as part of the Maximum Impact Programme funded for Teach First by the Goldman Sachs Foundation (Muijs et al., 2010; Muijs et al., 2012). Teach First is an alternative school based certification programme in England that was influenced by the earlier 'Teach for America' programme.

The VITAE research used national assessment data and contextualised value added approaches (statistical methods based on multilevel models) to study teacher effectiveness, based on pupil outcome data (tests and national assessments). It also

used questionnaires with teachers and students, and a series of in depth interviews with a sample of over 300 teachers. The research was longitudinal and studied teachers over more than three successive school years. The ECP study involved 81 teachers and adopted both quantitative and qualitative classroom observations conducted over two terms in one school year. It also employed teacher interviews and student surveys to gain information on classroom practice from different stakeholder perspectives. The Teach First evaluation also sought to triangulate its evidence base, employing questionnaire surveys, interviews with stakeholders, documents and performance data from students' test and examination results (again using value added multilevel statistical analyses) to study the variation in teachers' classroom practice through observations and evaluate the impact of Teach First practitioners on their schools' performance.

This chapter seeks to develop a framework to aid the reader in understanding and evaluating the quality of MM designs and research results. It compares the kinds of research questions addressed by these three different studies. It also highlights the sequencing of the research, the ways different kinds of data were analysed and linked and the processes of integration and synthesis. In addition, the chapter notes some of the methodological challenges faced, the knowledge claims made and how the authors substantiated their findings and conclusions.

What Is Mixed Methods Research?

The use of methods from different research traditions is not a new phenomenon in social and educational research. It has a long history and has supported the advancement of many disciplines. However, the term 'mixed methods (MM)' research has only emerged in the last two decades and with this the notion of classifying different types of MM designs. As Guest (2013:142) notes, 'Researchers in various disciplines were integrating qualitative and quantitative methods long before the field of mixed methods formally emerged and typologies were established.' Denzin (2010: 422) claims that the 'paradigm war' of the 1980s 'validated the use of mixed methods designs', rendering arguments denying the stronger inferences and diversity of findings offered by such designs as futile. Guest (2013) also highlights some interesting ways in which several classic early epidemiological and anthropological studies benefitted from the use of both quantitative and qualitative components to support groundbreaking and innovative investigations. For example, Guest points to John Snow's research into the 19th century cholera epidemic in London, where the use of a variety of methods led to the eventual identification a particular water pump as the source of the widespread infection. Snow talked to local residents about which water pumps they used regularly, produced a dot map of where each case of infection had taken place and made use of statistics correlating the quality of water and number of cholera cases to draw his final conclusions (Johnson, 2006). The roots of MM research are seen to go back more than half a century according to Hunter and Brewer (2003) although in this case the term 'multimethod' was used. Tashakkori and Teddlie (2003) sought to distinguish MM research from the more general term of multimethod to cover only those studies where both qualitative and quantitative components were intentionally

incorporated at the research design stage and reserve 'multimethod' for studies using several techniques from within the same paradigm (either qualitative or quantitative).

MM research has been identified in different ways in the methodological literature (see Tashakkori and Teddlie, 2003; 2010a; Johnson, Onwuegbuzie, and Turner, 2007). Teddlie and Sammons (2010) argue that MM research has emerged as an increasingly popular alternative to the traditional dichotomy evident between qualitative and quantitative research traditions in the social and behavioural sciences. Following the publication of the first and second Handbooks of Mixed Methods research (Tashakkori and Teddlie, 2003; 2010a) and the inception of a special Journal of Mixed Methods Research, MM is becoming recognised as a third and alternative methodological approach of increasing popularity. Teddlie and Sammons (2010) argue that its growing popularity 'is largely due to its flexibility in simultaneously addressing multiple and diverse research questions through integrated QUAL and QUANT techniques' (Teddlie and Sammons, 2010, p116).

In their second Handbook devoted to the topic, while reflecting on the development of MM approaches, Tashakkori and Teddlie (2010a) argue that MM refers to:

> The broad inquiry logic that guides the selection of specific methods and that is informed by conceptual positions common to mixed methods practitioners (e.g., the rejection of “either-or” choices at all levels of the research process). For us, this definition of methodology distinguishes the MMR approach to conducting research from that practiced in either the QUAN or QUAL approach.(2010a: 5).

These authors thus reject what they see as an arbitrary and often inappropriate opposition of qualitative and quantitative approaches as competing alternatives that researchers have to choose between, and the arguments that researchers must necessarily belong to only one or the other camp as suggested by, in their view the sterile and false dichotomy evident in many discussions in the so called 'paradigm wars' debates and in many traditional methodological text books. The appeal of MM research is thus seen to lie in the ability to combine both 'numbers and a story' (Spalter-Roth, 2000) to generate new knowledge because *'the combination of both general numeric findings and specific cases exemplifying those findings generate a synergy that neither can alone'* (Teddlie and Sammons, 2010: 116). Key to the definition is the notion of *integration* in terms of the way MM researchers choose to analyse, interpret and discuss their research in such a way that quantitative and qualitative components are seen to be purposively connected and findings *'mutually illuminating'* (Bryman, 2007:8).

Teddlie and Sammons (2010) suggest that such mutual illumination involves an inductive- deductive research cycle indicating a rejection of a linear approach to research and the creation of findings. They argue that MM research designs require creativity and flexibility in their construction and implementation. Although Tashakkori and Teddlie (2003) had distinguished a number of alternative ways of defining MM designs, some have suggested that the notion of typologies may not be that useful because *'the actual diversity in mixed methods studies is far greater than any typology can adequately encompass'* (Maxwell and Loomis, 2003: 244). Nonetheless, it is generally recognised that a loose typology of MM research designs and analytic techniques can be helpful to distinguish between five main families of designs, while recognising that any individual MM study may well be

unique in its particular way of conceptualising, analysing and integrating approaches, data and findings. Table 1 illustrates these five main 'families' of MM designs, their definition and the analytic approaches and techniques associated with each.

Insert Table 1 here.

Creswell (2003) drew attention to the need to move beyond the traditional and often oppositional quantitative or qualitative divide in designing research and evaluating knowledge claims that are made. He argued that instead research approaches should be thought of as lying somewhere along a continuum, and that although much research may still be largely qualitative or largely quantitative the third main approach of MM (purposive integration where different features of a study might be at different places on such a continuum) had come of age by the start of the twenty first century. Some go further to argue further that MM as a third methodological paradigm is particularly important for the investigation of complex social and behavioural phenomenon in the increasingly globalised and interconnected world of the 21st century. Creswell claims that the practice *of:*

> [R]esearch (such as writing a proposal) involves much more than philosophical assumptions. Philosophical ideas must be combined with broad approaches to research (strategies) and implemented with specific procedures (methods). Thus, a framework is needed that combines the elements of philosophical ideas, strategies, and methods into the three approaches to research. (2003: 4).

He goes on to propose three questions that should underpin the choice of research design:

1. What knowledge claims are being made by the researcher (including a theoretical perspective)?

2. What strategies of inquiry will inform the procedures?

3. What methods of data collection and analysis will be used?

These three questions are seen as helpful starting points in making an informed decision about whether a MM approach is deemed appropriate.

Creswell et al. (2011) provide an elaborated discussion of the role and nature of MM enquiry in a major review of the use of MM approaches in health related research. This defines MM in terms of five features as follows:

- focusing on research questions that call for real-life contextual understandings, multi-level perspectives, and cultural influences;
- employing rigorous quantitative research assessing magnitude and frequency of constructs and rigorous qualitative research exploring the meaning and understanding of constructs;
- utilizing multiple methods (e.g., intervention trials and in-depth interviews);
- intentionally integrating or combining these methods to draw on the strengths of each; and
- framing the investigation within philosophical and theoretical positions.

It is suggested that the three broad questions and this more elaborated set of five features outlined by Creswell (2003, 2011) provide a basis for those designing educational research to examine the quality and appropriateness of a MM design to address its stated research purposes and questions.

Creswell (2003) compared four main knowledge positions or paradigms: post positivism, constructivism (often combined with interpretivism), advocacy/participatory and pragmatism. Many MM researchers adopt the philosophical position of pragmatism arguing for the primacy of the research aims and underlying research questions in driving the choice of research design (see Tashakkori and Teddlie 1998; 2003 for a fuller discussion of pragmatism and the philosophical issues in relation to MM studies). A MM design thus should be adopted if the researchers judge that they will be better placed to achieve their purposes and address their research questions successfully through the application of methods from more than one tradition (qualitative or quantitative). Tashakkori and Teddlie (2003) refer to this primacy as the 'dictatorship' of the research questions in driving research designs and choice of methods. Hevaert et al. explicitly adopt a pragmatist stance arguing:

> [T]his implies that one should apply the best suited combination of methods and modes of analysis to answer the posed research question(s): that can be a monomethod or an MM approach. Emphasizing processes of abduction, intersubjectivity, and transferability (Morgan, 2007), pragmatism offers the researcher alternatives to the dichotomous choice between (post)positivism and constructivism, driven by the question of utility. (2013: 303)

This is in strong contrast to those that see alternative positions as antagonistic and mutually exclusive with the integration of findings seen as incommensurate due to fundamental differences in underlying philosophical assumptions and world views.

Salomon (1991) meanwhile argues that the differences between chosen approaches go beyond the 'quantitative-qualitative' debate. For example, a more 'controlled study of how specific variables affect others' may take an 'analytic approach', while a study investigating the complexities of educational environments, or 'a whole dynamic ecology, the building blocks of which cannot be easily (or usefully) separated' (1991: 12) will require a more 'systemic approach'. Salomon, espousing the work of Lakatos (1978) in distinguishing between theoretical and empirical progress, argues that:

> [T]he strength of the analytic approach lies in its ability to lead to empirical progress by testing specific causal hypotheses but that the theories from which the hypotheses are derived ought to emanate from a more systemic approach, possibly better capable of suggesting rich descriptive theories. (1991: 15)

Denzin (2010: 421) charts a rich history of the so-called 'paradigm wars' and describes three distinct periods:

1. the postpositivist war against positivism (1970-1990);

2. the wars between competing postpositivist, constructivist, and critical theory paradigms (1990-2005); and

3. the current war between evidence-based methodologists and the mixed methods, interpretive, and critical theory schools (2005 to present).

Denzin (2010: 422) seemingly reinterprets Tashakkori and Teddlie's (2003: 24) 'third methodological movement' as a 'third moment' and sets it against a quite revolutionary stance at the time based in the 'critical interpretive social science tradition' which seeks to reject altogether the norms and assumptions of objectivity and focuses more on the 'subversion of dominant paradigms. Entrenched in what would be Denzin's (2010) first war, some recognition emerged that all paradigms (however defined), methods and modes of description, interpretation and articulation are partial or incomplete individually (Feyerabend, 1974; Merton, 1975; Eisner, 1986). Salomon (1991: 16) concludes with the idea that complementarity 'serves better, fuller, and more satisfying understanding', with each approach informing and guiding the other. The debated 'incommensurability' of paradigms fades when concepts are reframed (Onwuegbuzie and Leech, 2005). Salomon (1991: 16) for example argues that 'the analytic approach capitalizes on precision while the systematic approach capitalizes on authenticity'. More recently, Onwuegbuzie and Teddlie (2003) sub-divide research into methods which are 'exploratory' and 'confirmatory'. Denzin (2010: 425) also calls for 'a moral and methodological community that honors and celebrates paradigm and methodological diversity'. Hall and Howard (2008: 250-251) refer to a 'synergistic' approach, where the combination or mixing of methods results in a sum greater than those of their individual components. Although qualitative and quantitative findings may concur or support each other, there may be discrepancies revealed. However, qualitative descriptions that contradict quantitative effects may lead in new directions and provide more complete, holistic or intricate understandings of phenomena.

Heyvaert et al. (2013) draw attention to the need to develop appropriate general criteria and frameworks for the critical appraisal of MM studies, reflecting that this

has become a recognised feature of good practice in evaluating the quality of quantitative and of qualitative research. They argue that developing such a recognised set of quality criteria is particularly important to enable MM studies to be properly evaluated and contribute to systematic reviews and best evidence syntheses. However, they note that, because any MM study should be more than just the sum of the individual qualitative and quantitative components, the application of qualitative and quantitative critical appraisal criteria to examine the separate components of a MM study is unlikely to be sufficient to establish the overall quality of an individual MM study. More is needed to address the *combination of methods* in the MM research and how this has shaped the overall findings. Heyvaert et al. (2013) make a comparison of different published critical appraisal frameworks for examining the quality of individual MM studies. They conclude that:

> The qualitative and quantitative strands of an MM study should not only be answering to strand-specific criteria; in addition, the strands should be appropriately mixed in order to answer the posed research questions, a rationale for the MMR approach should be provided, and the overall study should be coherent and insightful (Heyvaert et al., 2013: 317).

Tashakkori and Teddlie (2003; 2009) and Guest (2013) have discussed the merits and possible problems in seeking to develop typologies of MM designs. Tashakkori and Teddlie (2010a: 22) outline four main justifications for attempts to classify MM designs. Typologies:

- help to establish a 'common language' for the field;
- provide structure or ‘blueprint’ to the field;

- help to 'legitimize' the field
- are useful 'pedagogical tools' for students.

Leech and Onwuegbuzie (2009) present a framework involving three dimensions:

a) the level of mixing

b) time scale covered (distinguishing concurrent from sequential components), and

c) the primacy given to different approaches (are quantitative and qualitative components given equal status or is one dominant?).

The resulting typology outlines eight main types of MM design. Guest (2013) agrees that for novice researchers MM typologies may be useful in helping those unfamiliar with the conduct of MM enquiry in creating a workable design. This emphasises the didactic or pedagogical purposes of such classification, but he questions their value for experienced researchers and suggests they may be confusing or unworkable at least in some cases where the complexity and fluidity of some MM designs, especially those in larger projects, resists simple categorisation. In this chapter the position taken is to advise that for students and those new to the MM field typologies can be a very useful starting point to enhance their understanding of the different ways that MM designs can be conceived. However, they are best regarded as helpful illustrative tools, and should not be set in stone or applied slavishly. It is worthwhile for a researcher to see what can be learnt from such typologies and how far they may inform their own planning to achieve their particular research purposes. This can support methodological advancement (see above) but it is likely, and indeed one of the attractions and strengths of MM approaches that they are

flexible and encourage creativity on the part of the researcher, that there may be differences in the particular ways they choose to combine methods in any individual study. Again, following the pragmatist position, it is argued that the design decisions should be guided by the research purposes and research questions the student or researcher wants to pursue. As Tashakkori and Teddlie concluded no one typology can be exhaustive and fit all cases.

Guest (2013) makes an alternative proposal. Rather than focusing attention on the design of a MM study as a whole, he suggests a move to consider what he terms the *'points of interface*' between different data sets (qualitative and quantitative). He suggests this linguistic shift would help to identify more clearly the ways mixing occurs in any given study. The advantage claimed is that such a shift, *'*would provide an alternative way to describe the inherent complexity and fluidity of many mixed methods studies*'* (Guest, 2013:146). However, this does not eliminate the need to make explicit the actual MM design employed in any particular study as Guest (2013:146) goes on to say: 'Note that the details of the design would not be lost; they would simply be presented in the methods section of the report or proposal, as they would with any study.' While there is much merit in making more explicit the points of mixing as Guest suggests, we remain convinced that thinking about the nature of any particular MM design as a whole and its main features (as advocated by the study of typologies) and documenting this in relation to other main categories of MM designs identified by typologies remains of value for the reasons noted above, though we agree that adding a stronger emphasis to identify the points and nature of mixing of data is also most helpful.

Likewise, we argue that providing a clear and sufficiently detailed description of any MM study and its methods is vital in judging the rigour of a study and the robustness

of the knowledge claims that it makes. We agree with Guest (2013) that a diagram illustrating the various qualitative and quantitative research components and their application across the timescale of any investigation is likely to be helpful in understanding all MM studies and that it is vital in the case of complex, longitudinal MM studies where mixing occurs in more than one phase and in more than one way. Researchers should also seek to document clearly where, how, and why data sets are connected and mixed (the points of interface). This would help to highlight the way the various data collection, analysis, and interpretation stages of the research process are connected and, in particular, the way qualitative and quantitative data and findings are integrated. This is necessary to establish in what ways any MM attempts to achieve more than just being the 'sum' of its individual qualitative and quantitative components. Fetters and Freshwater (2015) provide further guidance on expectations from journal editors on publishing a methodologically mixed methods research article and what explanations and detail of the MM approach are deemed necessary. Their article also emphasises the value of diagrams to illustrate research designs and approaches to analysis.

Nine defining characteristics of MM research have been proposed by Tashakkori and Teddlie (2010a, 2010b). These defining characteristics provide a useful basis for informing, describing and evaluating MM designs.

- Methodological eclecticism
- Paradigm pluralism
- Emphasis on diversity at all levels of the research enterprise
- Emphasis on continua rather than a set of dichotomies

- Iterative, cyclical approach to research
- Focus on the research question (or research problem) in determining the methods used within any given study
- Set of basic ‘‘signature’’ research designs and analytical processes
- Tendency toward balance and compromise that is implicit within the ‘‘third methodological community’’
- Reliance on visual representations (e.g., figures, diagrams) and a common notational system

Tashakkori and Teddlie (2010b) argue that these help to distinguish MM from mono or multi method approaches and suggest that four of these characteristics are particularly relevant to the notion of putting the 'human' back in 'human' research methodology that they view as especially relevant to social and behavioural research. They suggest that the researcher shares concerns that link with the notion of humans as essentially 'everyday problem solvers' while using research knowledge and expertise in ways everyday problem solvers do not, and they use some educational examples to illustrate this idea. The four distinguishing characteristics they highlight in this connection are the strong focus on the research question in determining the methods used in any given study, the emphasis on adopting diversity in methods, methodological eclecticism, and an iterative, cyclical approach to the research and analysis.

Exemplars of MM Research in Education: A Focus on Teachers' Classroom Practice

Sammons (2010) and Teddlie and Sammons (2010) have drawn attention to the potential of MM approaches in educational effectiveness and improvement research. They suggest that MM designs can prove helpful in removing the historic over reliance on statistical analysis of student outcome data evident in many studies of school effectiveness that reveal the limitation of a narrow focus on measured outcomes, and the tendency for school improvement research to be limited to small scale, typically qualitative case studies of stakeholder perceptions and processes without reference to outcomes or ways of making generalizations. They argue that the focus on both 'numbers and a story' (Spalter-Roth, 2000) enables the combination of general statistical findings and thick descriptions of particular cases, 'has the potential to generate new insights and increase understanding of educational effectiveness research (EER) topics that neither can achieve alone . . . that allows MM research to add "extra value" to research studies seeking to better describe, predict, and understand social phenomena, such as the variation in and contributors to differences in educational effectiveness' (Sammons, 2010:699). Thus the use of MM approaches can help in both theory generation and theory testing in education, using a combination of inductive and deductive cycles where there is a 'to and fro' between analyses and findings across qualitative and quantitative components. This can enhance understanding of school and classroom processes. The combination of rigorous quantitative models, high quality case study and other qualitative approaches has the potential to further advance the educational effectiveness field and support closer links with that of school improvement. It can generate knowledge and evidence of more practical relevance and accessibility to

practitioners as well as contribute to theoretical model building, testing and understanding. Such research can also provide another way to study linkages across levels (school and classroom for example) in qualitative ways to add depth to the statistical models).

Here MM research studies are illustrated using three examples of studies of teachers' classroom practice. It is argued that the flexibility allowed by MM designs is particularly suited to the study of such a complex educational topic.

Example 1: Variations in Teachers' Work Lives and their Effects on Pupils (VITAE)

The VITAE research (Day et al.; 2006; 2007) was commissioned by the Department for Education and Skills (DfES) and conducted between 2001 and 2005. It involved a nationally representative sample of 300 primary (Key Stage 1 and 2) and secondary (Key Stage 3 English and mathematics) teachers working in 100 schools across seven local authorities (LAs) in England. Schools were selected to be representative of those in England in terms of levels of social disadvantage and attainment. The research sought to describe and analyse influences on teachers' professional and personal lives, their identities and effectiveness (both perceived and measured by student outcomes), and explore their interconnections. It also investigated connections between the school contexts in which they worked and these features. VITAE was included as an Associate Project of the Teaching and Learning Research Programme (TLRP). The study involved a team of researchers and a longitudinal MM design was chosen (Day et al., 2006, Sammons et al., 2007)

to reflect the complexity of the overarching research purposes and key questions that were all addressed by the both qualitative and quantitative components.

1. Does teacher effectiveness vary from one year to another and in terms of different pupil outcomes and do teachers necessarily become more effective over time?

2. What are the roles of biography and identity?

3. How do school and/or department leadership influence teachers' practice and their effectiveness?

4. What particular kinds of influence does continuing professional development (CPD) have on teachers' effectiveness?

5. Are teachers equally effective for different pupil groups or is there differential effectiveness relating (for example) to gender or socio-economic status?

6. Do the factors which influence effectiveness vary for teachers working in different school contexts, or for different kinds of outcomes?

7. Do factors influencing teachers' effectiveness vary across different sectors (primary and secondary) and different age groups (Key Stage 1, 2 and 3)?

Day et al. note that although government funded, the VITAE study:

> [W]as not intended to serve a policy research agenda, nor did it attempt to evaluate any interventions; nevertheless, it was certainly conducted in the context of the high government priority of raising standards in teaching and student attainment. The project specification included a focus on measurable student attainment but not to the exclusion of a wide-ranging investigation

aimed at a more holistic, nuanced understanding of teachers' work and lives. (2008a: 330)

The complex purposes and research questions led the researchers to use MM to investigate (a) a range of direct and indirect contributory influences on teachers' perceived effectiveness; (b) how the teachers managed these influences in various personal, professional, and policy contexts; and (c) whether there were associations between (a) and (b) and the measurable progress and attainment of the students under study' rather than only *'seeking simplistic cause-and-effect relationships'* by a narrower quantitative focus just on effectiveness as measured by statistical analyses of student outcomes.

The study design thus sought to link mainly quantitative research on teacher (and school) effectiveness on the one hand, and mainly qualitative research on teachers' work and lives on the other and integrate these different perspectives in order to better address the central research questions. In a methodological paper Day et al. (2008:331) sought to demonstrate how conceptual and methodological integration *'led to synergistic understandings that enabled the discovery and delineation of key findings that were both more enlightening and more robust than would have been the case if one method or another had dominated.*' They used examples of two key findings to illustrate how the MM design and points of interface in the analysis of data sets had enabled such synergy that went beyond the individual quantitative or qualitative findings of the research.

In addition to presenting details about the sample diagrammatically linked to the various data collection methods over the course of the longitudinal research that involved data collection across three full school years for sample of over 300

teachers, the authors provided more detailed tables indicating the methods used and the processes of data analysis (both qualitative and quantitative) and the way these were mixed across the course of the study (Sammons et al., 2007; Day et al., 2008). They provide an explicit account of how they sought to use case studies of the large teacher sample, to support data analysis and integration arguing that*:*

> [T]he construction of teacher case studies, the prime focus of the study, used three main sources of data: interviews, teacher and student questionnaires, and annual student assessment data. Case studies were developed for all 300 teachers, a process that involved qualitizing quantitative evidence, quantitizing qualitative evidence, and integrating the two (followed by a consequent synergistic interpretation). This interactive combination of data collection, ongoing analysis, tentative hypothesis generation, and testing and interpretation of results (see Day et al.., 2006, for an account of this process) provides greater mapping, analysis, interpretation, and holistic understandings of the research area than would be gained by relying on a single paradigm or approach.' (Day et al., 2008a: 333-334).

The authors also draw attention to the role of the mixed methods team and the focus on dialogue of both team members and data through regular meetings where the research process, data, collection methods, initial analyses and emerging results were regularly discussed as part of an iterative cyclical process. These involved the development of productive research relationships and understandings within the team, that included members with qualitative and quantitative , expertise, and experience. The role of *'*regular project workshops that focused on building shared understandings of data analyses, interpretations, and emergent themes' was

highlighted and this promoted 'the building of genuine good will and mutual support' (Day et al., 2008: 339). This was seen as a key factor in the processes of conceptual and methodological integration and synergy. The authors also state 'we would emphasize, especially, the need to sustain productive dialogue (in which the different data “talk” to each other) throughout the project’ (Day et al., 2008: 341).

The authors proposed a tentative model of how the research moved from conceptual and methodological integration to synergy (reproduced in Figure 1).

Insert Figure 1 here

Example 2: Effective Classroom Practice (ECP)

The ECP project (Day et al., 2008, Kington et al., 2011, 2014a) was separate from but built on the earlier VITAE research described in Example 1. It involved a number of the same team members (Day, Sammons, Kington) but was funded by a research council, not the government. It was initiated because it was recognised that lack of funding for a classroom observation component was a significant limitation of the original VITAE study. The ECP research sought to address this through a strong focus on observation. It had three broad aims:

1. To describe, analyse, and explain the variation in primary and secondary school teachers’ classroom behaviours and practice, focusing on English and mathematics teaching;

2. To explore typical and more effective classroom practice of teachers in Years 2, 6, and 9, across different school contexts, professional life phases, and ages in relation

to professional, situated, and/or personal factors, which are perceived to affect observed practice over time; and,

3. To draw out implications from the findings of (1) and (2) above for policy makers concerned with raising standards for schools and for teacher development.

The researchers make it clear that, 'the research was not trying to identify whether particular teachers were effective, rather to explore the practices, strategies, and methods used in classrooms by effective practitioners (where effectiveness indicators had already been developed to aid sampling) (Kington et al., 2014a: 31). They chose to use a purposive sample of teachers identified from previous research who either worked in schools in England that had been identified as significantly more effective in value added statistical analyses of national pupil performance data or had been identified as typical or more effective in analyses of pupil performance data in their own classes from the earlier VITAE research. The study was conducted between 2006 and 2008.

The researchers made an explicit case for using a MM design through linked concurrent quantitative and qualitative strands involving description, the study of patterns and associations and the deliberate integration of findings from different sources of data.

In an article on the research methodology published in the Journal of Mixed Methods Research the study's authors claimed: 'The strength of the study was in its mixed methods design with the actual observation of classroom practice the principal part of the research design' (Kington et al., 2011:10). These observations, conducted on two separate occasions in two different school terms involved the use of two quantitative systematic observation instruments: the International System of Teacher

Observation and Feedback (ISTOF) and the Quality of Teaching (QoT) schedules. Interestingly, the ISTOF schedule was developed by the Methodology of Research on Educational Effectiveness group using a MM process based on a review of literature on teacher effectiveness and the collection of qualitative data in the form of expert opinion from researchers across more than 19 countries (Teddlie et al., 2006). The QoT instrument was based on a collaborative project between the Dutch and English inspectorate and also involved expert opinion (van de Grift 2004; 2007). It has now been employed in published comparative quantitative studies of the variation in teachers' classroom practice across at least six countries in Europe (van de Grift et al., 2014).

In addition to these two quantitative schedules, the ECP study laid equal emphasis on the collection of qualitative observation data using, 'rich descriptive field notes to describe the lesson, which included detail on the structure, organization, and flow of the lesson; nature of lesson activities; interaction; classroom climate; and comments on the teacher's persona' (Kington et al., 2011: 10).

Teachers were also interviewed about their lives and work and their classroom practice to provide further detailed qualitative evidence. Both pre and post observation semi-structured interviews were conducted for each of the two observation lessons. Further quantitative data was obtained from teacher and pupil surveys.

The study also used repertory grids a technique developed through personal construct theory. These involved individual interviews with teachers to try and tap their personal constructs about teaching and effective classroom practice. Each teacher's personal constructs were written down and this provided additional rich

qualitative evidence on teachers' perspectives, in addition to that obtained from the more traditional semi structured interviews (see Kington et al. 2014b).

The authors use a discussion of the analysis of the repertory grid data to describe the analytic approach with involved both qualitative and quantitative elements and which enabled the development of a new quantitative instrument, a group grid that was based on the analysis of the original qualitative personal construct data. The constructs contained in the individual grids (more than 600 were identified across the teacher sample) were then categorised into 'themes.' as part of the qualitative analysis process. They explained that,

> The categorization process was done by the researchers involved in the actual construct elicitation interviews with participants. At the end of the categorization process, some 18 themes had been identified and these were expressed as bipolar constructs by eliciting the opposite poles to the themes. A new standard repertory grid (or group grid) was then designed using the original elements and the new bipolar construct themes. Ratings from the original grids were then inserted into the new standard grid, where there was a ‘‘match’’ between a construct used in the original grid and the new standard grid. (Kington et al., 2011: 14).

The 18 themes that emerged from the categorisation of teachers' personal constructs are shown below. These were then included in a group grid that could be used to establish the relative importance attached to different constructs across larger samples of teachers.

The ECP research addressed five main questions. The authors argued that to address these complex questions adequately required a variety of sources of

evidence and this again is linked with the rationale for using MM. These five questions that drove the research design are reported in Table 2 which shows how the various multiple data sources were linked with each question.

Insert Table 2 here

Insert Figure 2 here

Kington et al. (2011) use a diagram (Figure 2) to provide a visual representation of the ECP design and this illustrates various points of qualitative and quantitative linkage over the course of the research. They note also that there were some elements that worked sequentially within each of the phases of data collection in which the findings from one method were elaborated and expanded through another method (e.g., factors identified via teacher questionnaire explored in pre- and post-observation interviews). The design also allowed for data collected by one method to feed into more than one subsequent research instrument, examining the focus of the study from different perspectives (e.g., first round of teacher interviews fed into later interviews with school leaders and the pupil questionnaire. In view of this level of mixing the authors make the claim that the ECP approximates to a 'fully mixed, concurrent, multiphase, equal status, triangulation design' (Kington et al., 2011: 107).

Kington et al. (2014a: 33) provide a further discussion of the ECP's MM approach with a focus on design decisions. They claim that 'the demands of this project led to the development of an integrated, holistic approach involving the combination of a

range of research techniques, including those traditionally associated with both ‘‘quantitative’’ and ‘‘qualitative’’ paradigms'.

In the authors' view this enabled the ECP study to provide 'further insight and understanding of the factors that influence effectiveness and the relationships between (a) observed practice; (b) teacher, head teacher, and pupil perceptions; and (c) the analytical lenses of teachers’ professional life phase and teachers’ identity' (Kington et al., 2014a: 33). In line with the earlier VITAE study the researchers again chose to create individual teacher case studies as their prime focus for the point of interface where the mixing of the various qualitative and quantitative data took place. However, they also sought to provide an integration of the qualitative and quantitative approaches in relation to all stages of the research from the conceptualization of research questions, data collection, data analysis, and data interpretation as the following quote illustrates.

> To avoid qualitative (stories) and quantitative (statistical) elements of the research being designed and conducted separately . . . the process of integration began at the point of developing the research questions and continued through sampling, data collection, analysis, and reporting. The more detailed and holistic combination of approaches also allowed data, investigator, and methods triangulation (Denzin, 1978) and provided greater mapping, analysis, interpretation, and comprehension of the research area.' (Kington et al., 2014a: 33)

Example 3: Evaluation of Teach First

The evaluation of Teach First (Muij, et al., 2010; Muijs et al., 2012) sought to investigate the link between pedagogy and student outcomes as part of an evaluation of the impact of Teach First an alternative teacher certification programme.

The authors sought to conduct a 'theory based' evaluation adopting the theoretical framework of the Dynamic Model of Educational Effectiveness, DMEE (Creemers and Kyriakides, 2008) to inform its approach. They reported their two underlying purposes (evaluation and theory testing) as follows:

> The key aim of this study was to explore the extent to which Teach First teachers were effective classroom practitioners and could have a positive impact on student learning, and what factors could support them in being effective. On a theoretical level, we were interested in whether this study could provide any additional support to the DMEE (Muijs et al., 2012: 35).

Five linked research questions were described:

1. To what extent are Teach First teachers effective classroom practitioners, as perceived by school staff, external observers and colleagues?

2. Do Teach First teachers employ pedagogical approaches which are considered to be effective?

3. Is there any evidence that can support a positive impact on learning?

4. What factors can help or hinder them becoming effective practitioners?

5. Does this evaluation provide support for the DMEE?

In contrast to many MM investigations the authors made a particular emphasis on the value of adopting a theory driven approach to their investigation, with a strong link to the notion of 'a theory of action'. They argue that:

> A theory-driven evaluation approach assumes that we can use evaluation methodologies to illuminate theoretical models, linking evaluation of specific programmes to theories of change and action . . . A key element of theory-driven evaluation is that the evaluation goals and mechanisms are not driven exclusively by stakeholders and evaluation commissioners, but also relate to the theoretical underpinnings that may explain intended outcomes and mechanisms by which they are to be achieved. (Muijs et al., 2012: 32)

Their rational for adopting a MM design was linked to the need to collect a range of measures that linked with the Dynamic Model that underpinned the theory of change and action. These authors were of the opinion that tapping the variables of interest necessitated both qualitative and quantitative techniques. 'A mixed methods approach was used in this study, as the different variables in our view require different data collection strategies. This design aimed to provide breadth and depth, while ensuring the collection of rigorous and replicable data' (Muijs et al., 2012: 33).

The Teach First evaluation involved using secondary data analysis from the English National Pupil Database plus quantitative classroom observations. These were analysed to identify at the impact on teaching quality and student achievement. In addition, ‘qualitative data from case studies and interviews were used to develop deeper understanding of processes and facilitators and barriers to success' (Muijs et al., 2012: 33).

The MM evaluation team of researchers combined members with qualitative and quantitative expertise and the case study element of the evaluation was itself MM in approach. In total a sample of 16 schools and 47 Teach First (TF) teachers were studied. The schools varied in location but were all in areas of high social disadvantage, reflecting the aims and placement of TF teachers. For the classroom observations the ISTOF instrument (Teddlie et al., 2006) was adopted (in line with the ECP study noted in example 2) chosen because it had been internationally validated to measure effective classroom practices. In addition a range of semi structured interviews with TF teachers, their line managers and school head teachers were conducted.

The authors argued that there were many points of interface in their design that enabled the integration of the different sources. They described the iterative process of analysis as and the way this allowed earlier analyses results to inform later data collection stages. In addition they described how qualitative data were quantitized as a further round of analysis after initial qualitative analysis had taken place.

> Qualitative data collection and data analysis were closely integrated . . . This strategy allowed the team to check out hypotheses as they emerged from data analysis and refine data collection strategies as the study progressed. In addition to qualitative analysis, interview data were also analysed using content analytic methods. Content analysis is a summarising, quantitative analysis of messages that relies on the scientific method (including attention to objectivity-inter-subjectivity, a priori design, reliability, validity, generalizability, replicability, and hypothesis testing) and is not limited as to the types of variables that may be measured or the context in which the

> messages are created or presented . . . A coding scheme was developed and results quantified. (Muijs et al., 2012: 37)

The Teach First evaluation acknowledged a major weakness in its reliance on secondary analysis of pupil attainment because it was only possible to link students' results to schools not to individual teachers. This meant that they could only test the quantitative hypothesis that the number of TF teachers in a school might be related to value added measures of effectiveness in terms of student outcomes. This hypothesis was informed by the qualitative data analysis which had suggested that the numbers of TF teachers in a school could influence the school culture in terms of the notion of a critical mass as the following quote articulates. Again this provides an explicit illustration of the 'point of interface between the quantitative and qualitative data and its uses.

> In a second phase of the analyses, we explored whether the number of Teach First teachers who had worked in each of the Teach First schools affected the impact of their school. The hypothesis here is that a larger number of Teach First teachers might have a greater impact as a result of a greater impact on school culture, or through the facilitating effect of a critical mass of Teach First teachers as indicated in some of the qualitative data. (Muijs et al., 2012: 39)

Quantitative data on correlations between the number of TF teachers in the school were explored over time to test whether the critical mass hypothesis was supported by the data. In addition the qualitative data found that the critical mass of TF teachers in schools was borne out in terms of the analysis of barriers and facilitators of success.

The content analysis of interviews from line managers and head teachers was used to study the characteristics these stakeholders associated with TF teachers, and these qualitative themes were then quantitized to identify their relative prevalence and importance. Interviews with TF teachers themselves explored their perceptions of their own teaching approaches. It was revealed that they saw elements of constructivist and direct instruction teaching approaches, although a stronger emphasis on the latter. This finding was further tested from the quantitative observation data in terms of the ISTOF systematic observation rating scale.

Diagrams were used by these authors to illustrate the Dynamic Model link to their evaluation and to illustrate their quantitative analyses but, in contrast to the first two examples, they did not use a diagram to illustrate their research design. Nor did they seek to label their chosen design in terms of one of the five main design families discussed by Tashakkori and Teddlie (2003). In our view the TF study can be viewed as most closely aligned to the family of a Parallel Mixed Design. In addition, though not explicitly mentioned the authors' position again suggests a pragmatist philosophical position where the research design is, at least in part, driven by the research aims and research questions, including the wish to test the utility of the Dynamic Model for evaluation purposes.

Overview

This chapter has provided an introduction to the rationale for, and conduct of, MM research. It has discussed the rise of MM studies as a third methodological approach that is distinctive from either qualitative or quantitative approaches that have been more commonly used in past social research. In addition, it has examined the way MM designs may be classified and evaluated. Three examples of different MM studies that have sought to study teachers' classroom practice have been chosen to illustrate the variety in the way MM designs can be developed and linked using an educational focus. These examples indicate the way research purposes and research questions typically drive the choice of a MM approach, either explicitly or implicitly linking with a pragmatist philosophical position.

In addition these examples have been used to illustrate the importance attached to the inductive-deductive 'to and fro' of the research process linking qualitative and quantitative components so that they are mutually informative. The notion of the 'point of interface' as propounded by Guest (2013) has been introduced and instances to illustrate this identified in the three chosen examples. The value of typologies to document and examine different MM designs and the role of diagrams to illustrate such designs and the ways qualitative and quantitative components of a study (samples, methods, analysis phases) are combined has been highlighted.

Approaching the end of this chapter, we offer an 'alphabetical' set of linked questions which can help readers to critically appraise, interrogate and so better understand published MM research studies. We suggest these may also be useful to those who are interested in the potential of MM research but have not yet used such

designs as a basis to support their decision making in designing a new MM investigation.

The MM 'Alphabet': Questions to Support the Critical Appraisal of MM studies

Insert Figure 3 here

Petticrew and Roberts (2006) remind us that the criteria which are deemed to constitute 'methodological perfection' are likely to change over time, and that the goal of critical appraisal is to:

> [Assess] the degree to which a study is affected by bias and whether the degree of bias is large enough to render the study unusable. It is not simply a matter of "sorting the wheat from the chaff", but an assessment of whether the research is "fit for purpose". (2006: 131)

In relation to how environments of research and discovery evolve over time, we would therefore like to conclude this chapter by drawing a parallel between social science and the physical sciences or as Northcutt and McCoy (2004: 1) phrase, the 'ethereal world of subatomic particles':

> The qualitative researcher finds that the nature of both elements and relationships depends on complex interactions between the phenomenon that the system represents and the purpose and methods of interpretation brought to the phenomenon by the researcher. . . [which] creates a fascinating paradox. . . There are no universals or principles or grand *metanarrative*. On the other hand, seemingly disparate phenomena are often discovered to be

> fundamentally similar when analyzed from a systems point of view . . .' (2004: 1)

There is an often mistaken belief that the definitions and criteria of measurement in the natural sciences rarely change; fleeting classifications and meanings are reserved specially for the social sciences. One need only study the evolution of something seemingly "basic" such as the definition of the 'metre' as a unit of length to see that definitions change over time in *all* sciences, albeit within different mechanisms and resulting in different outcomes. Woolgar (1988: 18-19) argues that the 'organisation and conception of science has, at a general level, itself varied over time. In other words, the way in which science might be defined has itself varied in response to the organisational and social factors which bear upon its boundedness.' Niaz (2008) in his review of MM research programmes in education suggests that MM:

> [P]rovides a rationale for hypotheses/theories/guiding assumptions/presuppositions to compete and provide alternatives. This facilitates the reconstruction of historical episodes in physical science and cognitive psychology based on Galilean idealisations. The historical reconstruction helps to juxtapose empirical evidence in the context of arguments and counter-arguments of the different competing groups of researchers. (2008: 298)

Analogous to MM is the basis for chemical synthesis, which necessitates the breaking of existing bonds and formation of new ones (Encyclopaedia Britannica, 2015):

> For many compounds, it is possible to establish alternative synthetic routes. . . [K]nowledge of the reaction mechanism and the function of the chemical structure (or behaviour of the functional groups) helps to accurately determine the most-favoured pathway that leads to the desired reaction product.

Moving beyond even Lakatos' (1978) 'revolutions of science' and criteria for 'subsumption' (Walker, 2010: 438), MM may constitute a partial "bridge" between ideas around the history and philosophy of science that still prevail today: Kuhn's 'scientific revolutions' and Popper's principle of 'falsification'. Teddlie and Tashakkori (2009) explain that making inferences in MM research 'is both an art and science' and:

> [I]nvolves elements of creativity, intuition, and meaning making as well as the ability to compartmentalize components or aspects of a phenomenon, understand each, and then reconstruct them for a full understanding. (2009: 289)

Nowhere else is the contribution of MM approaches and techniques seen more clearly than in the area of educational effectiveness and improvement (Muijs, 2012):

> Working within a pragmatic paradigm that essentially rejects paradigmatic fundamentalism, and interested in both quantifiable impacts and the complex processes related to them, mixed methods were seen as providing a route towards integrating these two interests. . . Improvement researchers also frequently employed similar mixed methods designs, where, again, schools were selected on the basis of performance trajectories (have they improved significantly), which is then followed by case study work to ascertain what factors were related to this improvement trajectory. (2012: 59)

Notwithstanding Latour's (1993) declaration that 'we have never been modern', in an age where physicists, in an attempt to understand the Big Bang, are investigating and publically articulating new approaches to fuse the seemingly irreconcilable General Theory of Relativity and Quantum Theory (SciTechDaily, 2013), perhaps social scientists are at least getting closer to 'being open to new discoveries in *both* QUAL and QUAN research' (Teddlie and Tashakkori, 2009: 291. MM research continues to face the challenges of integrating and reconciling different paradigms, realities and epistemologies (amongst other factors) and also of creating appropriate integration and synthesis of findings with a MM lens to deepen understanding and create new knowledge that goes beyond what may be established using either a quantitative or qualitative perspective alone. This is certainly an exciting position of discovery, particularly for researchers of complex educational and social science topics, where before them lie a range of research problems to understand and explain, using the opportunities made available by the pursuit of rigorous and creative MM research.

References

BIPM - Bureau International des Poids et Mesures (1983) *Definition of the metre*. http://www.bipm.org/en/CGPM/db/17/1/

Bryman, A. (2007) The research question in social research: What is its role?. *International Journal of Social Research Methodology Theory and Practice*, 10(1): 5-20

Creemers, B. P. M. and Kyriakides, L. (2008) *The dynamics of educational effectiveness*, London: Routledge.

Creswell, J.W. (2003) *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, Thousand Oaks, CA: Sage Publications Inc.

Creswell, J. W., Klassen, A., Plano Clark, V. L. and Clegg Smith, C. (2011) *Best practices for mixed methods research in the health sciences.* Bethesda, MD: Office of Behavioral and Social Sciences Research, National Institutes of Health. http://obssr.od.nih.gov/scientific_areas/ methodology/mixed_methods_research/index.aspx

Day, C., Stobart, G., Sammons, P., Kington, A., Gu, Q., Smees, R. and Mujtaba, T. (2006) Variations in teachers' work, lives and their effects on pupils: VITAE Report (DfES Research Rep. No. 743). London: Department for Education and Skills.

Day, C, Sammons, P., Stobart, G, Kingston, A, Gu, Qing (2007) *Teachers Matter,* Milton Keynes: Open University Press.

Day, C., Sammons, P. and Gu, Q. (2008a) Combining Qualitative and Quantitative Methodologies in Research on Teachers' Lives, Work, and Effectiveness: From Integration to Synergy. *Educational Researcher*, 37(6): 330-342.

Day C., Sammons P., Kington A., Regan, E., Ko J., Brown E., Gunraj J. and Robertson D. (2008b) *Effective classroom practice (ECP): A mixed-method study of influences and outcomes*, End of Award Report submitted to the Economic and Social Research Council, School of Education, The University of Nottingham, Reference No. RES-000-23-1564.

Denzin, N. K. (2010) Moments, Mixed Methods, and Paradigm Dialogs, *Qualitative Inquiry*, 16(6): 419-427.

Denzin, N. K. (1978) *The research act: A theoretical introduction to sociological methods*. New York, NY: Praeger.

Eisner, E. (1986) The primacy of experience and the politics of method, *Educational Researcher*, 17(5), 15-20.

Encyclopaedia Britannica (2015) *Chemical Synthesis*. http://www.britannica.com/science/chemical-synthesis

Fetters, M. and Freshwater, D. (2015) Publishing a Methodological Mixed Methods Research Article, *Journal of Mixed Methods Research*, 9(3): 203-213.

Feyerabend, P. (1974) How to be a good empiricist—A plea for tolerance in matters epistemological. In: P. H. Niddick (Ed.), *The philosophy of science*, Oxford: Oxford University Press, 12-39.

Guest, G. (2013) Describing Mixed Methods research: An Alternative to Typologies, *Journal of Mixed Methods Research*, 7(2): 141-151.

Hall, B. and Howard, H. (2008) A Synergistic Approach Conducting Mixed Methods Research With Typological and Systemic Design Considerations, *Journal of Mixed Methods Research*, 2(3): 248-269.

Heyvaert, M., Hannes, K., Maes, B. and Onghena, P. (2013) Critical Appraisal of Mixed Methods Studies, *Journal of Mixed Methods Research*, 7(4): 302-327.

Hunter, A. and Brewer, J. (2003) Multimethod research in sociology in A. Tashakkori and C. Teddlie (eds*.) Handbook of mixed methods in social and behavioural research*, Thousand Oaks, CA: Sage Publications Inc, 577-594.

Johnson, S. (2006) *The Ghost Map*, London: Penguin Group.

Johnson, R.B. Onwuegbuzie, A. and Turner, L. (2007) Towards a definition of mixed methods research, *Journal of Mixed Methods Research*, 1(2) 112-133.

Kington, A., Reed, N. and Sammons, P. (2014b) Teachers' Constructs of Effective Classroom Practice: Variations across a career, *Research Papers in Education*, 29(5): 534-556.

Kington, A., Sammons, P., Regan, E., Brown, E. and Ko, J. with Buckler, S. (2014a) Effective Classroom Practice, Maidenhead: McGraw Hill Open University Press.

Kington, A., Sammons, P., Day, C. and Regan, E., (2011) Stories and Statistics: describing a mixed method study of effective classroom practice*. Journal of Mixed Methods Research,* 5(2): 103-125.

Lakatos, I. (1978) *The methodology of scientific research programs*. Cambridge, England: Cambridge University Press.

Latour, B. (1993) *We have never been modern*, Cambridge, Massachusetts: Harvard University Press.

Leech, N. and Onwuegbuzie, A. (2009) A typology of mixed methods research designs. *Quality & Quantity*, 43(2): 265-275.

Maxwell, J.A. and Loomis, D.M. (2003) Mixed methods design: an alternative approach. In: Tashakkori, A., Teddlie, C. (Eds.) *Handbook of Mixed Methods in Social and Behavioral Research*, Thousand Oaks, CA: Sage, 241–272.

Merton, R. K. (1975) Structural analysis in sociology. In P. Blau (Ed.), *Approaches to the study of social structure*, New York: The Free Press, 112-138.

Morgan, D. L. (2007) Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods, *Journal of Mixed Methods Research,* 1(1): 48-76.

Muijs, D. (2012) Methodological change in educational effectiveness research. In C. Chapman, P. Armstrong, A. Harris, D. Muijs, D. Reynolds and P. Sammons (Eds.) *School Effectiveness and Improvement Research, Policy and Practice: Challenging the orthodoxy?* Oxford, England: Routledge, 58-66.

Muijs, D., Chapman, C. and Armstrong, P. (2012) Teach First: Pedagogy and outcomes. The impact of an alternative certification programme, *Journal for Educational Research*, 4(2): 29–64

Muijs, D., Chapman, C. , Collins, A. and Armstrong, P. (2010) *Maximum Impact Evaluation The impact of Teach First teachers in schools An evaluation funded by the Maximum Impact Programme for Teach First Final Report,* University of Southampton & University of Manchester.

Niaz, M. (2008) A Rationale for Mixed Methods (Integrative) Research Programmes in Education, *Journal of Philosophy of Education*, 42(2): 287-305.

Northcutt, N. and McCoy, D. (2004) *Interactive Qualitative Analysis: A systems method for qualitative research*, Thousand Oaks, CA: Sage.

Onwuegbuzie, A. J. and Leech, N. L. (2005) Taking the ‘‘Q’’ Out of Research: Teaching Research Methodology Courses Without the Divide Between Quantitative and Qualitative Paradigms, *Quality & Quantity*, 39(3): 267-296.

Onwuegbuzie, A. J. & Teddlie, C. (2003) A framework for analyzing data in mixed methods research. In: A. Tashakkori and C. Teddlie (Eds.), *Handbook of Mixed Methods in Social and Behavioral Research*. Thousand Oaks, CA: Sage, 351–383.

Petticrew, M. and Roberts, H. (2006) *Systematic Reviews in the Social Sciences*, Oxford: Blackwell Publishing.

Salomon, G (1991) Transcending the Qualitative-Quantitative Debate: The Analytic and Systemic Approaches to Educational Research, *Educational Researcher*, 20(6): 10-18.

Sammons, P. (2010) The contribution of mixed methods to recent research on educational effectiveness. In A. Tashakkori and C. Teddlie (Eds.), *Sage handbook of mixed methods in social & behavioural research*, (2nd ed). Thousand Oaks, CA: Sage Publications Inc., 697-723.

Sammons, P., Day, C., Kington, A., Gu, Q., Stobart, G. and Smees, R. (2007) Exploring variations in teachers' work, lives and their effects on pupils: key findings and implications from a longitudinal mixed methods study, *British Educational Research Journal*, 33(5): 681-701.

SciTechDaily (2015) *Physicists Take a New Approach to Unify Quantum Theory and Theory of Relativity*. http://scitechdaily.com/physicists-take-new-approach-unify-quantum-theory-theory-relativity/

Spalter-Roth, R. (2000) Gender issues in the use of integrated approaches. In M. Bamberger (Ed.), *Integrating quantitative and qualitative research in development projects*, Washington, DC: The World Bank, 47-53.

Tashakkori, A. and Teddlie, C. (1998) *Mixed methodology: Combining qualitative and quantitative approaches.* Thousand Oaks, CA: Sage Publications, Inc*.*

Tashakkori, A. and Teddlie, C. (Eds.) (2003) *Handbook of mixed methods in social & behavioural research*. Thousand Oaks, CA: Sage Publications, Inc.

Tashakkori, A. and Teddlie, C. (Eds.) (2010a) *Handbook of mixed methods in social & behavioural research*. Thousand Oaks, CA: Sage Publications, Inc.

Tashakkori, A. and Teddlie, C. (2010b) Putting the Human Back in ‘‘Human Research Methodology’’: The Researcher in Mixed Methods Research, *Journal of Mixed Methods Research*, 4(4): 271-277.

Teddlie, C., Creemers, B., Kyriakides, L., Muijs, D. and Yu, F. (2006) The International System for Teacher Observation and Feedback: Evolution of an international study of teacher effectiveness constructs. *Educational Research and Evaluation,* 12, 561-582.

Teddlie, C. and Sammons, P. (2010) Applications of mixed methods to the field of educational effectiveness research. In B. P. M. Creemers, L. Kyriakides, and P. Sammons (Eds.) *Methodological advances in educational effectiveness research*. London: RoutledgeTaylor & Francis.

Teddlie, C. and Tashakkori, A. (2009) *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioural science*s. Thousand Oaks, CA: Sage.

van de Grift, W., Matthews, P., Tabak, L. and de Rijcke, F. (2004) Comparative research into the inspection of teaching in England and the Netherlands (HMI 2251). London, England: Ofsted.

van de Grift, W. (2007) Quality of teaching in four European countries: a review of the literature and application of an assessment instrument, *Educational Research*, 49(2): 127-152.

van de Grift, W., Helms-Lorenz, M. and Maulana, R. (2014) Teaching skills of student teachers: Calibration of an evaluation instrument and its value in predicting student academic engagement, *Studies in Educational Evaluation*, 43: 150-159.

Walker, T. (2010) The Perils of Paradigm Mentalities: Revisiting Kuhn, Lakatos, and Popper, *Perspectives on Politics*, 8(2): 433-451.

Woolgar, S. (1988) Science: *The Very Idea*, Chichester, England: Ellis Horwood.